iBiome - MRP User Guide

RAPTOR™

Intelligent Cyber Secure Platform

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GLOSSARY ENTRIES

802.1D

IEEE 802.1D is the Ethernet MAC bridges standard which includes Bridging, Spanning Tree and others. It is standardized by the IEEE 802.1 working group. It includes details specific to linking many of the other 802 projects including the widely deployed 802.3 (Ethernet), 802.11 (Wireless LAN) and 802.16 (WiMax) standards.
Bridges using virtual LANs (VLANs) have never been part of 802.1D, but were instead specified in separate standard, 802.1Q originally published in 1998.
By 2014, all the functionality defined by IEEE 802.1D has been incorporated into either IEEE 802.1Q (Bridges and Bridged Networks) or IEEE 802.1AC (MAC Service Definition).

802.1Q

IEEE 802.1Q, often referred to as DOT1Q or 1Q, is the networking standard that supports virtual LANs (VLANs) on an IEEE 802.3 Ethernet network. It is the most widely used encapsulation method for VLAN tagging.

802.1X

IEEE 802.1X is an IEEE Standard for port-based Network Access Control (PNAC). 802.1X authentication requires a client, an authenticator, and an authentication server. The client is a device that wants to connect to the network.

802.1W

IEEE 802.1W feature provides rapid traffic reconvergence for point-to-point links within a few milliseconds (0-500 milliseconds), following the failure of bridge or bridge point. This reconvergence occurs more rapidly than the reconvergence provided by the 802.1F spanning Tree Protocol (STP) or by RSTP.

AAA

Authentication, Authorization and Accounting (AAA) functionalities. AAA are provided by TACACS+. TACACS+ is used because it provides independently separate and modular authentication, authorization, and accounting (AAA) facilities achieved by a single access control server (the TACACS+ daemon).

AARP

AppleTalk Address Resolution Protocol (AARP). The AARP maps computers' physical hardware addresses to their temporarily assigned AppleTalk network addresses. AARP is functionally equivalent to Address Resolution Protocol (ARP). The AARP table permits management of the address mapping table on the managed device. This protocol allows Apple computers' AppleTalk hosts to generate their own network addresses

ABR

Area Border Router (ABR)

ACK

ACK stands for acknowledgment. ACK is one of the TCP flags.

TCP flags are various types of flag bits present in the TCP header. Each of them has its own significance. They initiate connections, carry data, and tear down connections. The commonly used TCP flags are SYN, ACK, RST, FIN, URG, PSH.

- SYN (synchronize): Packets that are used to initiate a connection.
- ACK (acknowledgment): Packets that are used to confirm that the data packets have been received, also used to confirm the initiation request and tear down requests.
- RST (reset): Signify the connection is down or maybe the service is not accepting the requests.
- FIN (finish): Indicate that the connection is being torn down. Both the sender and receiver send the FIN packets to gracefully terminate the connection.
- PSH (push): Indicate that the incoming data should be passed on directly to the application instead of getting buffered.
- URG (urgent): Indicate that the data that the packet is carrying should be processed immediately by the TCP stack

ACL

An access-control list (ACL) is a list of permissions associated with a system resource (object). An ACL specifies which users or system processes are granted access to objects, as well as what operations are allowed on given objects. Each entry in a typical ACL specifies a subject and an operation. For instance, if a file object has an ACL that contains (Admin: read, write; guest 1: read), this would give Admin permission to read and write the file, and only give guest 1 permission to read it.

AES

The Advanced Encryption Standard (AES) is a symmetric-key block cipher algorithm and U.S. government standard for secure and classified data encryption and decryption.

AH

The Authentication Header (AH) protocol provides data origin authentication, data integrity, and replay protection. However, AH does not provide data confidentiality, which means that all of your data is sent in the clear.

AH ensures data integrity with the checksum that a message authentication code, like MD5, generates. To ensure data origin authentication, AH includes a secret shared key in the algorithm that it uses for authentication. To ensure replay protection, AH uses a sequence number field within the AH header. It is worth noting here, that these three distinct functions are often lumped together and referred to as authentication. In the simplest terms, AH ensures that your data has not been tampered with en route to its final destination.

Although AH authenticates as much of the IP datagram as possible, the values of certain fields in the IP header cannot be predicted by the receiver. AH does not protect these fields, known as mutable fields. However, AH always protects the payload of the IP packet.

The Internet Engineering Task Force (IETF) formally defines AH in Request for Comment (RFC) 4302, IP Authentication Header.

AO

Authentication Option (AO). TCP-AO specifies the use of stronger Message Authentication Codes (MACs), protects against replays even for long-lived TCP connections, and provides more details on the association of security with TCP connections than TCP MD5. TCP-AO is compatible with either a static Master Key Tuple (MKT) configuration or an external, out-of-band MKT management mechanism; in either case, TCP-AO also protects connections when using the same MKT across repeated

instances of a connection, using traffic keys derived from the MKT, and coordinates MKT changes between endpoints.

ARAP

Apple Remote Access Protocol (ARAP); the Apple Remote Access Protocol (ARAP) sends traffic based on the AppleTalk protocol across PPP links and ISDN switched-circuit networks. ARAP is still pervasive in the Apple market, although the company is attempting to transition into an Apple-specific TCP stack for use over a PPP link.

ARP

ARP (Address Resolution Protocol). The ARP is a communication protocol used for discovering the link layer address, such as a MAC address, associated with a given Internet layer address, typically an IPv4 address.

AS

Autonomous System (AS)

ASBR

Autonomous Border System Router (ASBR)

Asdot

Asdot format is used when the 4-byte ASN are represented by their decimal value e.g. 100.1. BGP uses AS numbers as a fundamental part of its routing process. Because conventional 2-byte public AS numbers were becoming exhausted, the IANA increased the AS numbers by introducing a 4-byte AS numbers. The Asdot notation to represent these AS numbers is as follows.
For values between 0 and 65535, Asdot notation is simply the decimal value of the AS number. These values take up to 16 bits to express in binary. Examples include:

- 5
- 25
- 196
- 65000
- 65535

For values above 65536, Asdot notation splits the 32 bit binary value into two 16 bit values. These values are represented as two decimal numbers separated by a dot. Examples include:

- 0.65536
- 15.418
- 65535.8520
- 65535.65535

You will notice that for values of up to 65535, the Asdot is the same as the Asplain notation, and for values of 65536 and above, the Asdot is the same as the Asdot+ notation.

ASN

Autonomous System Number (ASN)

BDR

BDR stands for Backup Designated Router.

BFD

Bidirectional Forwarding Detection (BFD) is a super fast protocol that is able to detect link failures within milliseconds or even microseconds. BFD runs independent from any other (routing) protocols. Once it's up and running, you can configure protocols like OSPF, EIGRP, BGP, HSRP, MPLS LDP etc. to use BFD for link failure detection instead of their own mechanisms. When the link fails, BFD will inform the protocol

BGP

BGP (Border Gateway Protocol) is an Inter AS (Autonomous Systems) Routing Protocol that manages the distribution of Network Layer Reachability Information (NLRI) across AS. It is used to build an AS connectivity graph that is used to prune routing loops and enforce policies at AS level

BGP

BGP-4 is an extension of BGP-3 (BGP version 3),and it is the current version of BGP. BGP4 was published as RFC 4271 in 2006. Its major enhancement is the support for Classless Inter-Domain Routing (CIDR) and use of route aggregation to decrease the size of routing tables. The new RFC allows BGP4 to carry a wide range of IPv4 and IPv6 "address families".

BIDIR-PIM

Bi-directional Sparse Mode (PIM-SM); Derived from PIM-SM, BIDIR-PIM builds and maintains a bidirectional RPT, which is rooted at the RP and connects the multicast sources and the receivers. Along the bidirectional RPT, the multicast sources send multicast data to the RP, and the RP forwards the data to the receivers. Each router along the bidirectional RPT needs to maintain only one (*, G) entry, saving system resources.

Another difference between PIM sparse mode and PIM bidirectional mode is that with sparse mode traffic only flows down the shared tree. Using PIM bidirectional mode, traffic will flow up and down the shared tree. When the multicast packets arrive at the RP, they will be forwarded down the shared tree (if there are receivers) or dropped (when we don't have receivers).

BMS

Best Master Clock (BMS); The ordinary clock executes the port state machine and BMC (Best Master Clock) algorithm to select the *PTP* port state.

BOOTP

The Bootstrap Protocol (BOOTP) is a computer networking protocol used in Internet Protocol networks to automatically assign an IP address to network devices from a configuration server. The BOOTP was originally defined in RFC 951.

BPDU

Bridge Protocol Data Units (BPDUs) are frames that contain information about the spanning tree protocol (STP). A switch sends BPDUs using a unique source MAC address from its origin port to a multicast address.

There are two kinds of BPDUs for 802.1D Spanning Tree:

- Configuration BPDU, sent by root bridges to provide information to all switches.
- TCN (Topology Change Notification), sent by bridges towards the root bridge to notify changes in the topology, such as port up or port down.

BPS

BPS (Bits-per-second)

BR

Border Router (BR)

BSD

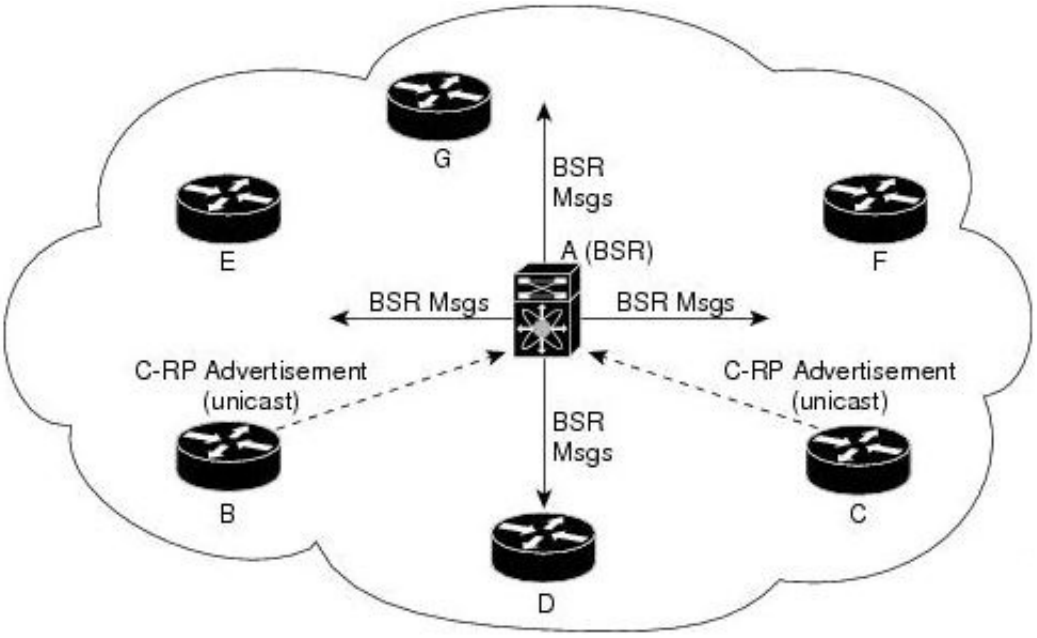
Berkeley Software Distribution (BSD)

BSR

The bootstrap router (BSR) ensures that all routers in the PIM domain have the same RP cache as the BSR. You can configure the BSR to help you select an RP set from BSR candidate RPs. The function of the BSR is to broadcast the RP set to all routers in the domain. You select one or more candidate BSRs to manage the RPs in the domain. Only one candidate BSR is elected as the BSR for the domain.

This figure shows the BSR mechanism. Router A, the software-elected BSR, sends BSR messages out all enabled interfaces (shown by the solid lines in the figure). The messages, which contain the RP set, are flooded hop by hop to all routers in the network. Routers B and C are candidate RPs that send their candidate-RP advertisements directly to the elected BSR (shown by the dashed lines in the figure).

The elected BSR receives candidate-RP messages from all the candidate RPs in the domain. The bootstrap message sent by the BSR includes information about all of the candidate RPs. Each router uses a common algorithm to select the same RP address for a given multicast group.



CA

Certificate Authorization (CA)

CBP

Customer Backbone Port (CBP)

CBS

Committed burst size (CBS). During periods of average traffic rates below the Committed information rate (CIR), any unused bandwidth capacity accumulates up to a maximum amount defined by the CBS. Short periods of bursting traffic (back-to-back traffic at averages rates that exceed the CIR) are also categorized as green provided that unused bandwidth capacity is available.

CEP

Customer Edge Port (CEP). The Customer Edge Port (CEP) and each Provider Edge Port are treated as separate Bridge Ports by the spanning tree protocol. If the C-VLAN component connects to the S-VLAN component with a single Provider Edge Port, and the associated service instance supports no more than two customer interfaces, then all frames (including Spanning Tree BPDUs) addressed to the Bridge Group Address may be relayed between the two Ports of the C-VLAN component without modification. Otherwise, the Spanning Tree Protocol Entity shall execute the Rapid Spanning Tree Protocol (RSTP, Clause 17 of IEEE Std 802.1D), as modified by the provisions of this subclause.

CFI

Canonical Format Identifier (CFI). If Drop Eligible Indicator (DEI) bit is enabled in 802.1ad header or has Canonical Format Identifier (CFI) bit enabled in 802.1q header on an arriving packet, such packets will be dropped using QoS.

MS-CHAP

CHAP stands for Challenge Handshake Authentication Protocol. MS-CHAP is the Microsoft version of the Challenge-Handshake Authentication Protocol, CHAP. The protocol exists in two versions, MS-CHAPv1 (defined in RFC 2433) and MS-CHAPv2 (defined in RFC 2759). MS-CHAPv2 provides mutual authentication between peers by piggybacking a peer challenge on the Response packet and an authenticator response on the Success packet.

CIDR

Classless Inter Domain Routing (CIDR).

CIR

Committed information rate (CIR) is defines the guaranteed bandwidth for traffic arriving at or departing from the interface under normal line conditions.

CIST

The Common and Internal Spanning Tree (CIST) is a collection of the ISTs in each MST region.

CLI

Command line interface (CLI) is a text-based interface that is used to operate software and operating systems while allowing the user to respond to visual prompts by typing single commands into the interface and receiving a reply in the same way

CLKIWF

CLKIWF is short for Clock InterWorking Function.

CoS

Output queue scheduling defines the class-of-service (CoS) properties of output queues. Based on certain types of traffic are preferred. The level of service is determined by the egress port queue to which the traffic is assigned. When traffic is queued for transmission, the rate at which it is serviced depends on how the queue is configured and possibly the amount of traffic present in other queues for that port.

Some traffic is classified for service (i.e., packet marking) before it arrives at the switch. If you decide to use these classifications, you can map this traffic to egress queues by setting the CoS in the Queue table.

CPLD

A Complex Programmable logic device (CPLD) is a logic device with completely programmable AND/OR arrays and macrocells. Macrocells are the main building blocks of a CPLD, which contain complex logic operations and logic for implementing disjunctive normal form expressions. AND/OR arrays are completely reprogrammable and responsible for performing various logic functions.

CPU

The central processing unit (CPU) is the primary component of a computer that processes instructions. It runs the operating system and applications, constantly receiving input from the user or active software programs. It processes the data and produces output.

CRT

CRT stands for "Internet security certificate.

CSR

Certificate Signing Request (CSR)

CST

common spanning tree (CST); The common spanning tree (CST) that interconnects the MST regions and single spanning trees

CTS

CTS stands for Clear to Send. Request to Send (RTS)/CTS Flow Control is another flow control mechanism that is part of the RS232 standard.

CVID

The C-VID registration table is as follows:

Table 1: C-VID registration table

C-VID Registration Table	Description
Cvid value	The value of the Customer VLAN id on the Customer edge port. (Table key)
Svid Value	The S-VLAN tag. Auto creates an S-VLAN component and the CNP and PNP and links the PEP of the C-VLAN component to the CNP.
Untagged-pep	A boolean indicating frames for this C-VLAN should be forwarded untagged through the Provider Edge Port (PEP).
Untagged-cep	A boolean indicating frames for this C-VLAN should be forwarded untagged through the Customer Edge Port (CEP).

CVLAN

Set of ports & inner VLANs (CVLAN); or C-VLAN or Customer Bridge (CB)

DB9

DB9 refers to a common connector type from the D-Subminiatures (D-Sub) connector family, which when introduced, was among the smallest connectors used on computer systems. DB9 houses 9 pins (for the male connector) or 9 holes (for the female connector). DB9 connectors were once very

common on PCs and servers. Today, the DB9 has mostly been replaced by more modern interfaces such as USB, PS/2, Firewire, and others.

DB25

The DB25 connector is an analog socket, with 25 pins, from the D-Subminiatures (D-Sub) connector family. The prefix “D” represents the D-shape of the connector shell. The DB25 connector is mainly used in serial and parallel ports, allowing asynchronous data transmission according to the RS-232 standard (RS-232C).

DCD

DCD stands Data Carrier Detect. The description is modem connected to another.

DEC

Digital Equipment Corporation (DEC)

DEI

Drop Eligible Indicator (DEI). If DEI bit is enabled in 802.1ad header or has Canonical Format Identifier (CFI) bit enabled in 802.1q header on an arriving packet, such packets will be dropped using QoS.

DES

The Advanced Encryption Standard (AES) is a symmetric-key block cipher algorithm and U.S. government standard for secure and classified data encryption and decryption.

DF

Designated Forwarder (DF).

DH

Diffie and Hellman (*DH*) describe a method for two parties to agree upon a shared secret number, called ZZ, in such a way that the secret will be unavailable to eavesdroppers. This method requires that both the sender and recipient of a message have key pairs (private and public). By combining one's private key and the other party's public key, both parties can compute the same shared secret number ZZ

DHCP

Dynamic Host Configuration Protocol (DHCP)

DITA

Darwin Information Typing Architecture (DITA); the DITA specification defines a set of document types for authoring and organizing topic-oriented information, as well as a set of mechanisms for combining, extending, and constraining document types.

D-LAG

Distributed Link Aggregation (D-LAG or DLAG)

DLF

The Destination Lookup Failure (DLF). When a packet arrives at the device and the device doesn't have an entry for the destination MAC address in its MAC address table, the packet is classified as a Destination Lookup Failure (DLF)

DM

DM stands for Dense Mode. Protocol-Independent Multicast Dense Mode (PIM-DM) uses dense multicast routing.

DNAT

Destination network address translation (DNAT) is a technique for transparently changing the destination IP address of an end route packet and performing the inverse function for any replies.

DNS

Domain Name System

DOT1Q

IEEE 802.1Q, often referred to as DOT1Q or 1Q, is the networking standard that supports virtual LANs (VLANs) on an IEEE 802.3 Ethernet network. It is the most widely used encapsulation method for VLAN tagging.

Dot1x

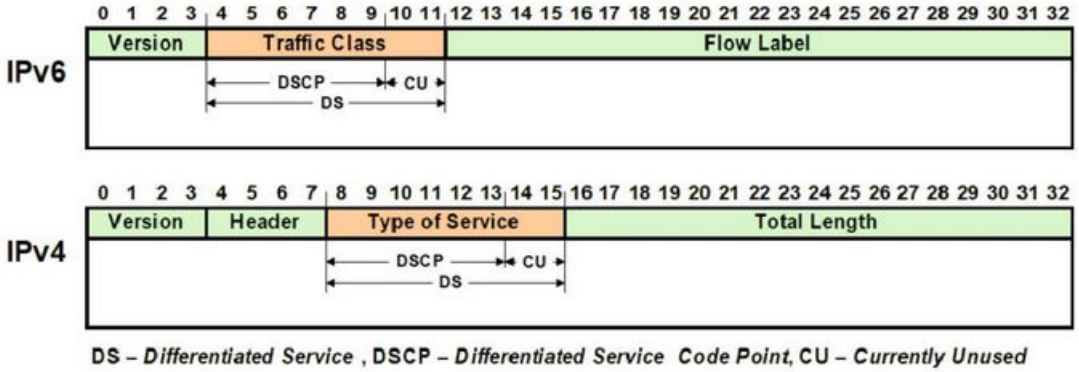
Dot1x Authentication is enabled when dot1x system-auth-control is enabled, and aaa authentication dot1x default is local. If you enable authentication on a port by using the default setting of dot1x port-control, which is force-authorized, it disables 802.1X authentication and causes the port to transition to the authorized state without any authentication exchange required. The port transmits and receives normal traffic without 802.1X-based authentication of the client

DR

The Designated Router (DR) is the router that will forward the PIM join message from the receiver to the RP (rendezvous point).

DS

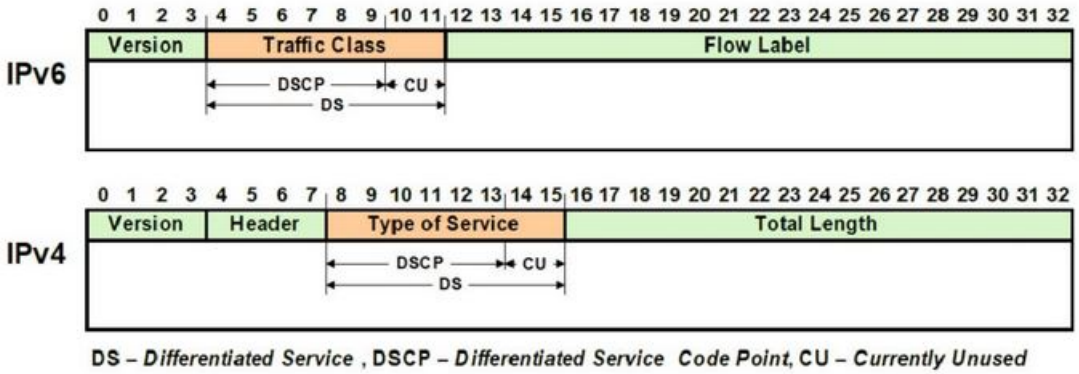
Differentiated Services (DS).



DS – *Differentiated Service* , DSCP – *Differentiated Service Code Point*, CU – *Currently Unused*

DSCP

A Differentiated Services Code Point (DSCP) is a packet header value that can be used to request (for example) high priority or best effort delivery for traffic.



DS – *Differentiated Service* , DSCP – *Differentiated Service Code Point*, CU – *Currently Unused*

DSR

DSR stands Data Set Ready. The description is ready to communicate.

DST

Daylight Saving Time (DST) is a system of setting clocks ahead so that both sunrise and sunset occur at a later hour. The effect is additional daylight in the evening. Many countries observe DST, although most have their own rules and regulations for when it begins and ends. The dates of DST may change from year to year

DTR

DTR stands Data Terminal Ready. The description is ready to communicate.

DUT

Device under Test (DUT)

DVMRP

Distance Vector Multicast Routing Protocol (DVMRP)

E2E

End-to-end (E2E) transparent clock for Precision Time Protocol (PTP). With an E2Etransparent clock, only the residence time is included in the timestamp in the packet.

EAP

Extensible Authentication Protocol (EAP) is an authentication framework frequently used in network and Internet connections. EAP is usually tunnelled over RADIUS between the Authenticator and the Authentication Server. 802.1x uses EAP.

EAP is an authentication framework, not a specific authentication mechanism. Commonly used modern methods capable of operating in wireless networks include EAP-TLS, EAP-SIM, EAP-AKA, LEAP and EAP-TTLS. Requirements for EAP methods used in wireless LAN authentication are described in RFC 4017.

The Lightweight Extensible Authentication Protocol (LEAP) method was developed by Cisco Systems prior to the IEEE ratification of the 802.11i security standard.

EAPOL

Extensible Authentication Protocol (EAP) over LAN (EAPoL) is used between the Supplicant (software on your laptop) and the Authenticator (switch)

EBGP

External *BGP* (EBGP); EBGP runs between two BGP routers in different Autonomous System (AS).

EBS

The Excess Burst size (EBS) specifies how much data above the committed burst size (CBS) a user can transmit. The EBS is the size up to which the traffic is allowed to burst without being discarded. EBS allows for moderate periods of bursting traffic that exceeds both the committed information rate (CIR) and the committed burst size (CBS).

ECN

Explicit Congestion Notification (ECN)

EGP

Exterior Gateway Protocol (EGP) is a defunct routing protocol used in autonomous systems to exchange data between surrounding gateway sites. Border Gateway Protocol (BGP) supplanted EGP, widely utilized by research institutes, universities, government agencies, and commercial

companies (BGP). EGP is built on poll instructions to request update answers and periodic message exchange polling for neighbor reachability.

EIGRP

Enhanced Interior Gateway Routing Protocol (EIGRP) is a network protocol that enables routers to exchange information more efficiently than earlier network protocols, such as Interior Gateway Routing Protocol (IGRP) or Border Gateway Protocol (BGP), and provides intelligent traffic sharing.

EIR

The excess information rate (EIR) specifies the rate above the CIR (committed information rate) at which traffic is allowed into the network and that may get delivered if the network is not congested. The EIR has an additional parameter associated with it called the excess burst size (EBS). The EBS is the size up to which the traffic is allowed to burst without being discarded.

ESD

ElectroStatic Discharge (ESD) is the sudden flow of electricity between two electrically charged objects caused by contact, an electrical short or dielectric breakdown. A buildup of static electricity can be caused by tribocharging or by electrostatic induction. The ESD occurs when differently-charged objects are brought close together or when the dielectric between them breaks down, often creating a visible spark.

EXEC

exec: Protocol
Commands that are invoked using the exec: protocol must be executable as standalone commands. Commands that are built into a command interpreter or other program cannot be executed directly, but must be executed (if possible) within the context of the application that provides them. For example, the following seed URL would not work on Microsoft Windows systems because the dir command is built into the Windows command interpreter (cmd.exe):
exec: dir e:\data
To use the exec protocol with commands that are built into the Windows command interpreter, you must do something as the following:
exec: cmd /c dir 'e:\data'

ESP

Encapsulation Security Protocol (ESP); the ESP protocol provides data confidentiality, and also optionally provides data origin authentication, data integrity checking, and replay protection. The difference between ESP and the Authentication Header (AH) protocol is that ESP provides encryption, while both protocols provide authentication, integrity checking, and replay protection. With ESP, both communicating systems use a shared key for encrypting and decrypting the data they exchange.

EVB

Edge Virtual Bridge (EVB) is an IEEE standard that involves the interaction between virtual switching environments in a hypervisor and the first layer of the physical switching infrastructure. The EVB enhancements are following 2 different paths – 802.1qbg and 802.1qbh.

EVC

Ethernet Virtual Connection (EVC).

FCS

A frame check sequence (FCS) is an error-detecting code added to a frame in a communication protocol. Frames are used to send payload data from a source to a destination.

FDB

Forwarding Database (FDB)

FID

Filtering ID (FID)

FHRP

First Hop Redundancy Protocol (FHRP)

FPGA

The Field Programmable Gate Array (FPGA) is a programmable logic device that can have its internal configuration set by the firmware.

FTP

The File Transfer Protocol (FTP) is a standard communication protocol used for the transfer of computer files from a server to a client on a computer network. FTP is built on a client–server model architecture using separate control and data connections between the client and the server.[1] FTP users may authenticate themselves with a clear-text sign-in protocol, normally in the form of a username and password, but can connect anonymously if the server is configured to allow it. For secure transmission that protects the username and password, and encrypts the content, FTP is often secured with SSL/TLS (FTPS) or replaced with SSH File Transfer Protocol (SFTP).

GARP

GARP (Generic Attribute Registration Protocol) is a local area network (LAN) protocol that defines procedures by which end stations and switches can register and deregister attributes, such as network identifiers or addresses, with each other. Every end station and switch thus has a record, or list, of all the other end stations and switches that can be reached at any given time.
When an attribute for an end station or switch is registered or deregistered according to GARP, the set of reachable end stations and switches, called participants, is modified according to specific rules. The defined set of participants at any given time, along with their attributes, is a subset of the network topology called the reachability tree. Data frames are propagated only to registered end stations. This prevents attempts to send data to end stations that are not reachable.

GGP

Gateway-to-Gateway Protocol (GGP) is an obsolete protocol defined for routing datagrams between Internet gateways. It was first outlined in 1982. The GGP was designed as an IP datagram service similar to the TCP and the UDP.

GMRP

GARP Multicast Registration Protocol (GMRP) is a Generic Attribute Registration Protocol (GARP) application that provides a constrained multicast flooding facility similar to IGMP snooping.

GND

Ground

GPS

Global Positioning System

GR

Graceful Restart (GR)

GRE

Generic routing encapsulation (GRE) is an IP encapsulation protocol which is used to transport IP packets over a network. In GRE, an IP datagram is tunnelled (encapsulated) within another IP data-

gram.One great advantage of GRE is that it allows routing of IP packets between private IPv4 networks which are separated over public IPv4 Internet. GRE also supports encapsulating IPv4 broadcast and multicast traffic.

GVRP

GVRP (GARP VLAN Registration Protocol or Generic VLAN Registration Protocol) is a protocol that facilitates control of virtual local area networks (VLANs) within a larger network. GVRP conforms to the IEEE 802.1Q specification, which defines a method of tagging frame s with VLAN configuration data

HA

High Availability (HA)

HDMI

HDMI (High-Definition Multimedia Interface) is digital interface capable of transmitting high-quality and high-bandwidth streams of audio and video between devices

HOL

Head-Of-Line (HOL) blocking should be prevented on a port. HOL blocking happens when HOL packet of a buffer cannot be switched to an output port (i.e. HOL occurs when a line of packets is held up by the first packet).

HSR

High-availability Seamless Redundancy (HSR) is a network protocol for Ethernet that provides seamless failover against failure of any single network component. PRP and HSR are standardized by the IEC 62439 and are suited for applications that request high availability and no switchover time.

HTTP

Hyper Text Transfer Protocol (HTTP)

HTTPS

Hyper Text Transfer Protocol Secure (HTTPS)

IANA

Internet Assigned Numbers Authority (IANA)

IBGP

Internal BGP (iBGP) is the protocol used between the routers in the same autonomous system (AS). iBGP is used to provide information to your internal routers. iBGP requires all the devices in same AS to form full mesh neighborship or either of Route reflectors and Confederation for prefix learning.

ICMP

Internet Control Message Protocol

IDPR

Inter-domain Routing Protocol (IDPR). The objective of IDPR is to construct and maintain routes, between source and destination administrative domains, that provide user traffic with the requested services within the constraints stipulated for the domains transited.

IETF

Internet Engineering Task Force (IETF) is an open standards organization, which develops and promotes voluntary Internet standards, in particular the technical standards that comprise the Internet protocol suite (TCP/IP).

IGMP

The Internet Group Management Protocol (IGMP) is a communications protocol used by hosts and adjacent routers on IPv4 networks to establish multicast group memberships. IGMP is an integral part of IP multicast and allows the network to direct multicast transmissions only to hosts that have requested them.

IGP

Interior Gateway Protocol (IGP) is a type of routing protocol used for exchanging routing table information between gateways (commonly routers) within an autonomous system (for example, a system of corporate local area networks). This routing information can then be used to route network-layer protocols like IP.

IGRP

Interior Gateway Routing Protocol (IGRP) is a proprietary distance vector routing protocol that manages the flow of routing information within connected routers in the host network or autonomous system. The protocol ensures that every router has routing tables updated with the best available path. IGRP also avoids routing loops by updating itself with the changes occurring over the network and by error management.

IGS

The Internet Group Management Protocol (IGMP) Snooping (IGS) is designed to prevent hosts on a local network from receiving traffic for a multicast group they have not explicitly joined. It provides switches with a mechanism to prune multicast traffic from links that do not contain a multicast listener (an IGMP client). Essentially, IGS is a layer 2 optimization for the Layer 3 IGMP.

IKE

Internet Key Exchange (IKE)

IP

Internet Protocol (IP).

IPSec

IPSec (Internet Protocol Security) is a suite of protocols that provides security to Internet communications at the IP layer. The most common current use of IPSec is to provide a Virtual Private Network (VPN), either between two locations (gateway-to-gateway) or between a remote user and an enterprise network (host-to-gateway); it can also provide end-to-end, or host-to-host, security.

IPv4

IPv4 and IPv6 are Internet protocol version 4 and Internet protocol version 6. IPv4 supports:

- IPv4 has a 32-bit address length
- IPv4 binary bits are separated by a dot(.) whereas IPv6 binary bits are separated by a colon(:).
- IPv4 is a numeric addressing method whereas IPv6 is an alphanumeric addressing method
- It Supports Manual and DHCP address configuration
- In IPv4 end to end, connection integrity is Unachievable
- It can generate 4.29×109 address space
- Fragmentation performed by Sender and forwarding routers
- In IPv4 Packet flow identification is not available
- In IPv4 checksum field is available
- It has broadcast Message Transmission Scheme

- In IPv4 Encryption and Authentication facility not provided
- IPv4 has a header of 20-60 bytes.

IPv6

IPv6 stands for Internet protocol version 6. An IPv6 address consists of eight groups of four hexa-decimal digits. Anexample of IPv6 address is as follows
3001:0da8:75a3:0000:0000:8a2e:0370:7334
there are different ypes of IPv6 addresses:

- Unicast addresses—it identifies a unique node on a network and usually refers to a single sender or a single receiver.
- Multicast addresses—it represents a group of IP devices and can only be used as the destination of a datagram.
- Anycast addresses—it is assigned to a set of interfaces that typically belong to different nodes.

IRDP

ICMP Router Discovery Protocol (IRDP) allows hosts to locate routers that can be used as a gateway to reach IP-based devices on other networks. When the device running IRDP operates as a router, router discovery packets are generated. When the device running IRDP operates as a host, router discovery packets are received. ICMP stands for Internet Control Message Protocol.

IRTP

Internet Reliable Transaction Protocol (IRTP) is a transport level host to host protocol designed for an Internet environment. It provides reliable, sequenced delivery of packets of data between hosts and multiplexes / demultiplexes streams of packets from/to user processes representing ports.

ISAKMP

Internet Security Association and Key Management Protocol (ISAKMP)

ISDN

Integrated Services Digital Network (ISDN)

ISL

ISL stands for Inter-Switch Link which is one of the VLAN protocols. The ISL is proprietary of Cisco and is used only between Cisco switches. It operates in a point-to-point VLAN environment and supports up to 1000 VLANs and can be used over Fast Ethernet and Gigabit Ethernet links only.

ISP

Internet service provider (ISP)

ISS

Intelligent Switch Solution (ISS).

IST

The Internal Spanning Tree (IST) instance receives and sends BPDUs to the CST. The IST can repre-sent the entire MST region as a CST virtual bridge to the outside world.

IVL

Independent VLAN Learning (IVL)

IVR

Inter VLAN Routing (IVR)

IWF

InterWorking Function (IWF).

KDF

Key Derivation Functions (KDFs); TCP-AO's Traffic_Keys are derived using KDFs. As per RFC5926, when invoked, a KDF generates a string of length Output_Length bit based on the Master_Key and context value. This result may then be used as a cryptographic key for any algorithm that takes anOutput_Length length key. A KDF MAY specify a maximum Output_Length parameter.

L2GP

Layer 2 Gateway Port (L2GP)

LA

Link Aggregation

LACP

Link Aggregation Control Protocol

LAG

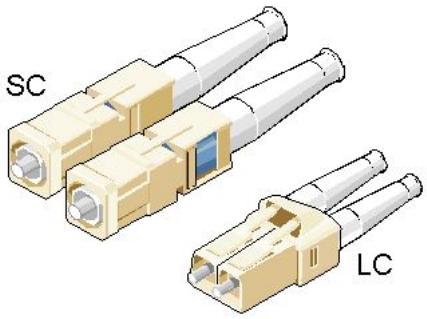
Link Aggregation Group

LAN

Local Area Network

LC

LC (Lucent Connector) is a miniaturized version of the fiber-optic SC (Standard Connector) connector. It looks somewhat like the SC, but is half the size with a 1.25mm ferrule instead of 2.5mm.



SC and LC Connectors

LED

Light-emitting diode (LED) is a widely used standard source of light in electrical equipment.

LLDP

Link Layer Discovery Protocol (LLDP)

LM

Line Module (LM)

LSA

Link State Advertisement (LSA)

LSDB

link state database (LSDB)

LSR

Link State Routing (LSR)

MAC

Media access control (MAC) is a sublayer of the data link layer in the seven-layer OSI network reference model. MAC is responsible for the transmission of data packets to and from the network-interface card, and to and from another remotely shared channel.

MAU

Medium Attachment Unit (MAU)

MD5

Message Digest Algorithm 5 (MD5) is a cryptographic hash algorithm that can be used to create a 128-bit string value from an arbitrary length string.

A hash function provides encryption using an algorithm and no key. A variable-length plaintext is “hashed” into a (typically) fixed-length hash value (often called a “message digest” or simply a “hash”). Hash functions are primarily used to provide integrity; if the hash of a plaintext changes, the plaintext itself has changed.

Common older hash functions include Secure Hash Algorithm 1 (SHA-1), which creates a 160-bit hash and Message Digest 5 (MD5), which creates a 128-bit hash.

Although there has been insecurities identified with MD5, it is still widely used, and its most common use is to verify the integrity of files.

MDI

Media Independent Interface (MDI) and Media Independent Interface with Crossover (MDIX) are basically ports on a computer and a network switch, router, or hub, respectively.

MDIX

Media Independent Interface with Crossover (MDIX) and Media Independent Interface (MDI) are basically ports on a computer and a network switch, router, or hub, respectively.

MED

1) Media Endpoint Discovery (MED); LLDP does not contain the capability of negotiating additional information such as PoE management and VLAN assignments. This capability was added as an enhancement known as Media Endpoint Discovery or MED, resulting in the enhanced protocol LLDP-MED.The MED enhancement has been standardized by the Telecommunications Industry Association in standard number ANSI/TIA-1057.
2) Multi Exit Discriminator (MED) for routes received from different autonomous systems; MED is one of the parameters considered for selecting the best path among many alternative paths. The path with a lower MED is preferred over a path with a higher MED.

MHRP

Multipath Hybrid Routing Protocol (MHRP) is a multipath routing protocol for hybrid Wireless Mesh Network (WMN), which provides security and uses technique to find alternate path in case of route failure.

MIB

Management Information Base (MIB) is the hierarchical database used by the simple network management protocol (SNMP) to describe the particular device being monitored.

MIB OID

Management Information Base (MIB) is the hierarchical database used by the simple network management protocol (SNMP) to describe the particular device being monitored.
MIB Object IDentifier (OID), as known as a MIB object identifier in the SNMP, is a number assigned to devices in a network for identification purposes. OID numbering is hierarchical. Using the IETF notation of digits and dots, resembling very long IP addresses, various registries such as ANSI assign high-level numbers to vendors and organizations. They, in turn, append digits to the number to identify individual devices or software processes.

MIC

Media redundancy Interconnection Client (MIC) is a member node of a MRP Interconnect ring.

MIM

Media redundancy Interconnection Manager (MIM) is a node in a MRP Interconnect ring which acts a redundancy manager.

MLDS

Multicast Listener Discovery Snooping (MLDS) constrains the flooding of IPv6 multicast traffic on VLANs. When MLDS is enabled on a VLAN, adevice examines MLD messages between hosts and multicast routers and learns which hosts are interested in receiving traffic for a multicast group. On the basis of what it learns, the device then forwards multicast traffic only to those interfaces in the VLAN that are connected to interested receivers instead of flooding the traffic to all interfaces.

MKT

Master Key Tuple (MKT). TCP-AO uses cryptographic algorithms to convert MKTs, which can be shared across connections, into unique traffic keys for each connection.

MM

MultiMode (MM) Mode is in optical fiber with a larger core than singlemode fiber. Typically, MM has a core diameter of 50 or 62.5 μm and a cladding diameter of 125 μ.

MIC

Media redundancy Interconnection Client (MIC) is a member node of a MRP Interconnect ring.

MPLS

Multiprotocol Label Switching (MPLS) is a routing technique in telecommunications networks that directs data from one node to the next based on short path labels rather than long network addresses, thus avoiding complex lookups in a routing table and speeding traffic flows. The labels identify virtual links (paths) between distant nodes rather than endpoints. MPLS can encapsulate packets of various network protocols, hence the "multiprotocol" reference on its name.

MRA

Media Redundancy Automanager (MRA). To configure a Media Redundancy Automanager (MRA), the node or nodes elect an MRM by a configured priority value.

MRC

Media Redundancy Client (MRC) is a member node of a MRP ring.

MRM

Media Redundancy Manager (MRM) is a node in the network which acts a redundancy manager.

MRP

Media Redundancy Protocol (MRP) is a networking protocol designed to implement redundancy and recovery in a ring topology.

MSR

1) MSR (MIB Save and Restore).
2) Model-Specific Register (*MSR*)

MST

MST (Multiple Spanning Tree) is the version of STP that allows multiple VLANs to a single instance. It is the standard based protocol defined with IEEE 802.1s. Unlike other spanning tree protocols, in which all the spanning tree instances are independent, MST establishes and maintains IST, CIST, and CST spanning trees.

MSTI

Multiple spanning trees, called MSTIs; inside an MST region, multiple spanning trees, called MSTIs, are calculated. Among these MSTIs, MSTI 0 is the IST.

MSTP

Multiple Spanning-Tree Protocol

MTU

Maximum Transmission Unit (MTU)

MVLAN

Multicast VLANs (MVLAN)

NAP

Network Access Protection (NAP)

NAPT

Network address port translation (NAPT) is a variation of the traditional *NAT*. NAPT extends the notion of translation one step further by also translating transport identifiers (e.g., TCP and UDP port numbers, ICMP query identifiers).

NAS

The Network Access Server (NAS) is the front line of authentication – it's the first server that fields network authentication requests before they pass through to the RADIUS. The NAS Identifier (NAS-ID) is a feature that allows the RADIUS server to confirm information about the sender of the authentication request.

NAT

Network address translation (NAT) is a method of mapping an IP address space into another by modifying network address information in the IP header of packets while they are in transit across a traffic routing device.

NBMA

NBMA (Non Broadcast Multi Access)

NBNS

NetBIOS Name Server where NetBIOS stands for Network Basic Input / Output System.

NC

NC (normally closed) is a closed (short) circuit creating a path for the current.

ND

Neighbor Discovery (ND); the Virtual Router Redundancy Protocol (*VRRP*) for IPv6 provides a much faster switchover to an alternate default router than can be obtained using standard neighbor discovery (ND) procedures.

NETBIOS

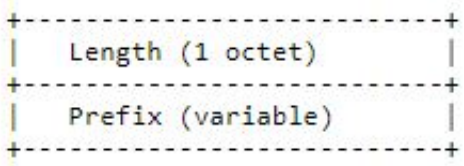
Network Basic Input / Output System (NETBIOS)

NIP

This set of fields are a vector of N IP unicast addresses, where the value N corresponds to the Number or Sources (N) field.

NLRI

Network Layer Reachability Information (NLRI). The Network Layer Reachability information is encoded as one or more 2-tuples of the form <length, prefix>, whose fields are described below.



NMS

Network Management System (NMS)

NO

NO (normally open) is an open circuit not creating a path for the current.

NPS

Network Policy Server (NPS)

NSSA

Not-so-stubby Area (NSSA)

NTP

Network Time Protocol (NTP)

NVP

Network Voice Protocol (NVP) was a pioneering computer network protocol for transporting human speech over packetized communications networks. It was an early example of Voice over Internet Protocol technology.

NVRAM

Non-volatile random-access memory (NVRAM) is random-access memory that retains data without applied power. This is in contrast to dynamic random-access memory (DRAM) and static random-access memory (SRAM), which both maintain data only for as long as power is applied, or such forms of memory as magnetic tape, which cannot be randomly accessed but which retains data indefinitely without electric power.

OID

Object IDentifier

ORF

Outbound Route Filter (ORF); the BGP Prefix-Based ORF feature uses BGP ORF send and receive capabilities for minimizing the number of BGP updates that are sent between BGP peers. Configuring this feature can help reduce the amount of system resources required for generating and processing routing updates by filtering out unwanted routing updates at the source.

OSPF

Open Shortest Path First routing protocol

OUI

organization unique identifiers (OUI)s. LLDP enables defining optional *TLV* units by using organization unique identifiers (OUIs) or organizationally-specific TLVs. An OUI identifies the category for a *TLV* unit depending on whether the OUI follows the IEEE 802.1 or IEEE 802.3 standard.

P2P

Peer-to-peer (P2P) transparent clock for Precision Time Protocol (PTP).

PAE

Port Access Entity (PAE). 802.1X-2001 defines two logical port entities for an authenticated port—the "controlled port" and the "uncontrolled port". The controlled port is manipulated by the 802.1X PAE (Port Access Entity) to allow (in the authorized state) or prevent (in the unauthorized state) network traffic ingress and egress to/from the controlled port. The uncontrolled port is used by the 802.1X PAE to transmit and receive EAPOL frames.

PAP

Password Authentication Protocol (PAP) is a password-based authentication protocol used by Point to Point Protocol (PPP) to validate users. PAP stops working after establishing the authentication; thus, it can lead to attacks on the network.

PBB

Provider backbone bridging (PBB) extends Layer 2 Ethernet switching to provide enhanced scalability, quality-of-service (QoS) features, and carrier-class reliability.

PC

Personal Computer

PCB

Provider Core Bridge (PCB) or S-VLAN Bridge; PCB integrates only one S-VLAN component. It is capable of providing single service on a port.

PDU

A Protocol Data Unit (PDU) is a single unit of information transmitted among peer entities of a computer network. A PDU is composed of protocol-specific control information and user data.

P/E

Program/Erase (P/E). Writing a byte to flash memory involves two steps: Program and Erase (P/E). P/E cycles can serve as a criterion for quantifying the endurance of a flash storage device.

PEB

Provider Edge Bridge (PEB); Provider Edge Bridge integrates one S-VLAN component with zero or many C-VLAN components as well as integrates each C-VLAN (up to 4094 C-VLANs) individually with a different S-VLAN (up to 4094 S-VLANs).

PEM

PEM (originally “Privacy Enhanced Mail”) is the most common format for X.509 certificates, CSRs, and cryptographic keys. A PEM file is a text file containing one or more items in Base64 ASCII encoding, each with plain-text headers and footers (e.g. -----BEGIN CERTIFICATE----- and -----END CERTIFICATE-----). A single PEM file could contain an end-entity certificate, a private key, or multiple certificates forming a complete chain of trust. Most certificate files downloaded from SSL.com will be in PEM format

PEP

Provider Edge Port (PEP). The Customer Edge Port and each Provider Edge Port are treated as separate Bridge Ports by the spanning tree protocol. If the C-VLAN component connects to the S-VLAN component with a single Provider Edge Port, and the associated service instance supports no more than two customer interfaces, then all frames (including Spanning Tree BPDUs) addressed to the Bridge Group Address may be relayed between the two Ports of the C-VLAN component without modification. Otherwise, the Spanning Tree Protocol Entity shall execute the Rapid Spanning Tree Protocol (RSTP, Clause 17 of IEEE Std 802.1D), as modified by the provisions of this subclause.

PFS

Perfect Forward Secrecy (PFS) means that a piece of an encryption system automatically and frequently changes the keys it uses to encrypt and decrypt information, such that if the latest key is compromised, it exposes only a small portion of the user's sensitive data.
If PFS is specified in the IPSec policy, a new Diffie-Hellman exchange is performed with each quick mode, providing keying material that has greater entropy (key material life) and thereby greater resistance to cryptographic attacks. Each Diffie-Hellman exchange requires large exponentiations, thereby increasing CPU use and exacting a performance cost.

PHB

PHB (Per Hop Behavior) is a term used in differentiated services (DiffServ) or multiprotocol label switching (MPLS). It defines the policy and priority applied to a packet when traversing a hop (such as a router) in a DiffServ network.

PHY

A PHY, an abbreviation for "physical layer", is an electronic circuit, usually implemented as an integrated circuit, required to implement physical layer functions of the OSI model in a network interface controller. A PHY connects a link layer device (often called MAC as an acronym for medium access control) to a physical medium such as an optical fiber or copper cable. A PHY device typically includes both physical coding sublayer (PCS) and physical medium dependent (PMD) layer functionality. PHY may also be used as a suffix to form a short name referencing a specific physical layer protocol, for example M-PHY.

PIM

Protocol-Independent Multicast (PIM) is a family of multicast routing protocols for Internet Protocol (IP) networks that provide one-to-many and many-to-many distribution of data over a LAN, WAN or the Internet. It is termed protocol-independent because PIM does not include its own topology discovery mechanism, but instead uses routing information supplied by other routing protocols. PIM is not dependent on a specific unicast routing protocol; it can make use of any unicast routing protocol in use on the network. PIM does not build its own routing tables. PIM uses the unicast routing table for reverse-path forwarding.
There are four variants of PIM:

- PIM Sparse Mode (PIM-SM) explicitly builds unidirectional shared trees rooted at a rendezvous point (RP) per group, and optionally creates shortest-path trees per source. PIM-SM generally scales fairly well for wide-area usage.
- PIM Dense Mode (PIM-DM) uses dense multicast routing. It implicitly builds shortest-path trees by flooding multicast traffic domain wide, and then pruning back branches of the tree where no receivers are present. PIM-DM is straightforward to implement but generally has poor scaling prop-

erties. The first multicast routing protocol, DVMRP used dense-mode multicast routing. See the PIM Internet Standard RFC 3973.

- Bidirectional PIM (Bidir-PIM) explicitly builds shared bi-directional trees. It never builds a shortest path tree, so may have longer end-to-end delays than PIM-SM, but scales well because it needs no source-specific state. See Bidirectional PIM Internet Standard RFC 5015, 70–73 .
- PIM Source-Specific Multicast (PIM-SSM) builds trees that are rooted in just one source, offering a more secure and scalable model for a limited number of applications (mostly broadcasting of content). In SSM, an IP datagram is transmitted by a source S to an SSM destination address G, and receivers can receive this datagram by subscribing to channel (S,G). See informational RFC 3569

Bidirectional (Bidir) *PIM*

Bidirectional PIM (Bidir-PIM) explicitly builds shared bi-directional trees. It never builds a shortest path tree, so may have longer end-to-end delays than PIM-SM, but scales well because it needs no source-specific state. See Bidirectional PIM Internet Standard RFC 5015, 70–73.

PIM-DM

Protocol-Independent Multicast Dense Mode PIM-DM) uses dense multicast routing. It implicitly builds shortest-path trees by flooding multicast traffic domain wide, and then pruning back branches of the tree where no receivers are present. PIM-DM is straightforward to implement but generally has poor scaling properties.

PIM-SM

Protocol-Independent Multicast Sparse Mode (PIM-SM) explicitly builds unidirectional shared trees rooted at a rendezvous point (RP) per group, and optionally creates shortest-path trees per source. PIM-SM generally scales fairly well for wide-area usage.

PING

Packet INternet Groper (PING or Ping)

PIP

Provider Instance Port (PIP)

PIR

Peak Information Rate (PIR) is a burstable rate set on routers and/or switches that allows throughput overhead. Related to committed information rate (CIR) which is a committed rate speed guaranteed/capped.

PMBR

PIM Multicast Border Router (PMBR)

PMTU

Path Maximum Transmission Unit (PMTU)

PNAC

Port Based Network Access Control (PNAC), or 802.1X, authentication requires a client, an authenticator, and an authentication server. The client is a device that wants to connect to the network.

PNP

Provider Network Ports (PNP)

PoE

Power over Ethernet (PoE) is distributing power over an Ethernet network. Because the power and signal are on the same cable, PoE enables remote network devices such as ceiling-mounted access points, surveillance cameras and LED lighting to be installed far away from AC power sources.

PPP

- Point-to-Point Protocol (PPP); The user or machine sends a request to a Network Access Server (NAS) to gain access to a particular network resource using access credentials. The credentials are passed to the NAS device via the data link layer (L2) protocol—for example, Point-to-Point Protocol (PPP) in the case of many dial up or DSL providers or posted in an HTTPS secure web form.
- Protocol Packet Processing (PPP)

PPVID

Port and Protocol *VLAN* ID (PPVID)

PRP

Parallel Redundancy Protocol (PRP) is a network protocol standard for Ethernet that provides seamless failover against failure of any network component. This redundancy is invisible to the application.PRP nodes have two ports and are attached to two separated networks of similar topology. This is in contrast to the companion standard HSR (IEC 62439-3 Clause 5), with which PRP shares the operating principle.

PS

Power Supply

PTP

Precision Timing Protocol

PVID

Port *VLAN* ID (PVID)

PVLAN

Private VLAN (PVLAN); Private VLAN, also known as port isolation, is a technique in computer networking where a VLAN contains switch ports that are restricted such that they can only communicate with a given uplink. The restricted ports are called private ports

PVRST

Per VLAN Rapid Spanning-Tree

PVRSTP

Per VLAN Rapid Spanning-Tree Protocol

PW

An Ethernet pseudowire (PW) is used to carry Ethernet/802.3 Protocol Data Units (PDUs) over an MPLS network. See RFC 4448 for details.

Q-in-Q

802.1Q tunneling (Q-in-Q) is a technique often used by Ethernet providers as a layer 2 VPN for customers. During 802.1Q (or dot1q) tunneling, the provider will put an 802.1Q tag on all the frames that it receives from a customer with a unique VLAN tag. By using a different VLAN tag for each customer we can separate the traffic from different customers and also transparently transfer it throughout the service provider network.

QoS

Quality of Service (QoS) refers to traffic prioritization and resource reservation control mechanisms rather than the achieved service quality. QoS defines the ability to provide different priorities to different applications, users, or data flows or the ability to guarantee a certain level of performance to a data flow.

QRV

Querier's Robustness Variable (QRV).

RADIUS

Remote Authentication Dial-In User Service

RAM

Random-access memory (RAM) is a form of computer memory that can be read and changed in any order, and typically is used to store working data and machine code.

RARP

The Reverse Address Resolution Protocol (RARP) is an obsolete computer communication protocol used by a client computer to request its Internet Protocol (IPv4) address from a computer network, when all it has available is its link layer or hardware address, such as a MAC address.

RBAC

Role Based Authentication (RBAC)

RED

1) Random early detection (RED) is where a single queue may have several different sets of queue thresholds.
2) Redundant interface (RED) or Red (e.g. RED 1 or RED 2).

RFD

A flapping route is an unstable route that is advertised and withdrawn over and over again. Every time a flap occurs, a BGP UPDATE message is sent. When routers have to process many BGP UPDATE messages, their CPU load increases.
BGP route dampening can be used to prevent installing flapping BGP routes and forwarding them to other BGP routers. This decreases the CPU load of routers and increases network stability. Nowadays, routers are powerful enough to process BGP updates so dampening isn't considered a best practice anymore
RFP has 5 attributes - the default values are shown

- Penalty
- Suppress-Limit - 2000
- Half-Life - 900 secs
- Reuse limit - 750
- Maximum Suppress-Limit -3600 secs (60 min)

When the route exceeds the suppress limit, the route is dampened.Once the route is dampened, the router won't install the route in the routing table nor advertise it to other BGP neighbor.
If for example the penalty is 4000 and the half-life time is 15 minutes. After 15 minutes the penalty will be 2000, after another 15 minutes, the penalty is 1000, and after another 15 minute, the penalty is 500. Once the penalty is below the reuse limit of 750, the route can be used again and

advertised to other BGP routers. When the penalty is below 50% of the reuse limit, the penalty is removed from the route.
The maximum suppress limit ensures that a route won't be dampened forever. The maximum suppress time is 3600 secs or 60 minutes by default.

RFL

Route Reflector Client (RFL); The route reflector allows all IBGP speakers within your autonomous network to learn about the available routes without introducing loops

RIB

Routing Information Base (RIB); Routing and routing functions in enterprise and carrier networks are typically performed by network devices (routers and switches) using an RIB. Protocols and configuration push data into the RIB and the RIB manager installs state into the hardware for packet forwarding.

RIP

RIP (Routing Information Protocol) sends routing-update messages at regular intervals and when the network topology changes. When a router receives a routing update that includes changes to an entry, it updates its routing table to reflect the new route. The metric value for the path is increased by 1, and the sender is indicated as the next hop. RIP routers maintain only the best route (the route with the lowest metric value) to a destination. After updating its routing table, the router immediately begins transmitting routing updates to inform other network routers about the change. These updates are sent independently of the regularly scheduled updates that RIP routers send. RIP uses a hop count as a way to determine network distance. Each host with a router in the network uses the routing table information to determine the next host to route a packet for a specified destination.

RMON

Remote network monitoring (RMON) is the process of monitoring network traffic on a remote Ethernet segment for detectingnetwork issues such as dropped packets, network collisions, and traffic congestion

RP

Rendezvous point (RP)

RPF

RPF stands for Reverse Path Forwarding. PIM uses reverse-path forwarding (RPF) to prevent multicast routing loops by leveraging the unicast routing table on the virtual router. When the virtual router receives a multicast packet, it looks up the source of the multicast packet in its unicast routing table to see if the outgoing interface associated with that source IP address is the interface on which that packet arrived. If the interfaces match, the virtual router duplicates the packet and forwards it out the interfaces toward the multicast receivers in the group. If the interfaces don't match, the virtual router drops the packet. *This is called a RPF failure.*

RPT

Root Part Tree (RPT)

RRD

Route Redistribution (RRD)

RSVP

Resource Reservation Protocol (RSVP) is a transport layer protocol designed to reserve resources across a network using the integrated services model. RSVP operates over an IPv4 or IPv6 and provides receiver-initiated setup of resource reservations for multicast or unicast data flows.

RS-232

RS-232 is a short range connection between a single host and a single device (such as a PC to a modem) or another host (such as a PC to another PC). The standard uses a single TX line, a single RX line, numerous modem handshaking lines and a ground line with the option of DB9 and DB25 connectors. A minimal 3-wire RS-232 connection consists only the TX, RX, and ground lines, but if flow control is required a minimal 5-wire RS-232 is used adding the RTS and CTS lines. The RS-232 standard has been commonly used in computer serial ports and is still widely used in industrial communication devices.

RS-422

RS-422 was meant as a replacement for RS-232 as it offered much higher speeds, better immunity to noise and allow for longer cable lengths making it better suited to industrial environments. The standard uses the same signals as the RS-232 standard, but used differential twisted pair so requires double the number of wires as RS-232. Connectors are not specified in the standard so block or DB connectors are commonly used. RS-422 cannot implement a true multi-point communications network since there can be only one driver on each pair of wires. However, one driver can fan-out to up to ten receivers.

RS-485

RS-485 standard addresses some short coming of the RS-422 standard. The standard supports inexpensive local networks and multidrop communication links, using the same differential signalling over twisted pairs as RS-422. The main difference being that in RS-485 drivers use three-state logic allowing the individual transmitters to deactivate while not transmitting, while RS-422 the transmitter is always active therefore holding the differential lines. Up to 32 devices can be connected, but with repeaters a network with up to 256 devices can be achieved. RS-485 can be used in a full-duplex 4-wire mode or half-duplex 2-wire mode. With long wires and high baud-rates it is recommended that termination resistors are used at the far ends of the network for signal integrity

RST

RST stands for reset. RST is one of the TCP flags.
TCP flags are various types of flag bits present in the TCP header. Each of them has its own significance. They initiate connections, carry data, and tear down connections. The commonly used TCP flags are SYN, ACK, RST, FIN, URG, PSH.

- SYN (synchronize): Packets that are used to initiate a connection.
- ACK (acknowledgment): Packets that are used to confirm that the data packets have been received, also used to confirm the initiation request and tear down requests.
- RST (reset): Signify the connection is down or maybe the service is not accepting the requests.
- FIN (finish): Indicate that the connection is being torn down. Both the sender and receiver send the FIN packets to gracefully terminate the connection.
- PSH (push): Indicate that the incoming data should be passed on directly to the application instead of getting buffered.
- URG (urgent): Indicate that the data that the packet is carrying should be processed immediately by the TCP stack.

RSTP

Rapid Spanning-Tree Protocol

RT

Route Target (RT) value; RT can be used to share routes among them. We can apply route targets to a VRF to control the import and export of routes among it and other VRFs. When you configure RT import, it imports all prefixes that match the configured RT value as one of the attributes in the BGP update. So in any-any VRF, it is common to see all PE configured with same RT value

RTM

Routing Table Manager (RTM). The RTM is the central repository of routing information for all routing protocols that operate under the routing and remote access service (RRAS). It provides routing information to all interested clients, such as routing protocols, management programs, and monitoring programs. The RTM also determines the best route to each destination network that is known to the routing protocols. The determination of this route is based on routing protocol priorities and on the metrics associated with the routes.

RTS

Request to Send (RTS)/CTS Flow Control is another flow control mechanism that is part of the RS232 standard.

RX

Receive

SA

Security Associations (SA). A SA is a relationship between two or more entities that describes how the entities will utilize security services to communicate securely. In endpoint-to-endpoint Transport Mode, both end points of the IP connection implement IPSec.

SAN

Singly attached nodes (SAN); singly attached nodes don't have the same redundancy as the doubly attached nodes since they still have just one connection that could fail.

SEM

State Event Machines (SEM)

SFP

SFP (Small Form-factor Pluggable) is a small transceiver that plugs into the SFP port of a network switch and connects to fibre channel and gigabit Ethernet (GbE) optical fiber cables at the other end. The SFP converts the serial electrical signals to serial optical signals and vice versa. SFP modules are hot swappable and contain ID and system information for the switch.

SFTP

SSH File Transfer Protocol (SFTP)

SHA

Secure Hash Algorithm is the name of a series of hash algorithms.
A hash function provides encryption using an algorithm and no key. A variable-length plaintext is “hashed” into a (typically) fixed-length hash value (often called a “message digest” or simply a “hash”). Hash functions are primarily used to provide integrity; the hash of a plaintext changes, the plaintext itself has changed.
Common older hash functions include Secure Hash Algorithm 1 (SHA-1), which creates a 160-bit hash and Message Digest 5 (MD5), which creates a 128-bit hash.

SIP

Session Initiation Protocol (SIP) is mostly well known for establishing voice and video calls over the Internet. To initiate such sessions, SIP uses simple request and response messages. For example, the INVITE request message is used to invite a user to begin a session and ACK confirms the user has received the request. The response code 180 (Ringing) means the user is being alerted of the call and 200 (OK) indicates the request was successful. Once a session has been established, BYE is used to end the communication.

SISP

Switch Instance Shared Port (SISP)

SLA

Service-level agreements (SLA).

SLIP

Serial Line Internet Protocol (SLIP); SLIP is the predecessor protocol of Point-to-Point Protocol (PPP). SLIP does not provide authentication, is a static IP addressing assignment, and data is transferred in synchronous form.

SM

State Machine

SNAT

Static Network Address Translation (SAT, SNAT) performs one-to-one translation of internal IP addresses to external ones.

SNMP

Simple Network Management Protocol

SNTP

Simple Network Time Protocol (SNTP)

SPT

Shortest path tree (SPT) is used for multicast transmission of packets with the shortest path from sender to recipients.

SR

State Refresh (SR) message. For a given (S,G) tree, SR messages will be originated by all routers that use an interface directly connected to the source as the RPF interface for the source. Ref: IETF “State Refresh in PIM-DM”

SRM

State Refresh Message (SRM). For a given (S,G) tree, SRM will be originated byall routers that use an interface directly connected to the source as the RPF interface for the source. Ref: IETF “State Refresh in PIM-DM”

SSD

SSD (Solid State Drive) is an all-electronic, non-volatile random access storage drive.

SSH

(Secure SHell) is a security protocol for logging into a remote server. SSH provides an encrypted session for transferring files and executing server programs on all platforms. Also serving as a secure client/server connection for applications such as database access and email, SSH supports a variety of authentication methods.

SSL

Secure Sockets Layer

SSM

Source-Specific Multicast (SSM)

SST

Single Spanning Tree (SST); SST is formed in either of the following situations:

- A switch running STP or RSTP belongs to only one spanning tree.
- An MST region has only one switch.

STP

Spanning Tree Protocol (STP) is a Layer 2 protocol that runs on bridges and switches. The specification for STP is IEEE 802.1D. The main purpose of STP is provide path redundancy while preventing undesirable loops in the network.

SVL

Shared VLAN Learning (SVL)

S-VLAN

Stacked VLAN (S-VLAN)

TAC

Taxonomy Access Control (TAC) allows the user administrator to control access to nodes indirectly by controlling which roles can access which categories.

TACACS

Terminal Access Controller Access-Control System

TAI

International Atomic Time (TAI); if the port is in the master state, the local clock is synchronized to an external source of time traceable to TAI (International Atomic Time) and UTC (Universal Coordinated Time) such as GPS (Global Positioning System) system.

TB

Token Bucket (TB). The TB algorithm is based on an analogy of a fixed capacity bucket into which tokens, normally representing a unit of bytes or a single packet of predetermined size, are added at a fixed rate. When a packet is to be checked for conformance to the defined limits, the bucket is inspected to see if it contains sufficient tokens at that time. If so, the appropriate number of tokens, e.g. equivalent to the length of the packet in bytes, are removed ("cashed in"), and the packet is passed, e.g., for transmission. The packet does not conform if there are insufficient tokens in the bucket, and the contents of the bucket are not changed.

TC

TC (Topology Change); once the Root Bridge is aware of a change in the topology of the network, it sets the Topology Change (TC) flag on the sent BPDs.

TCN

TCN (Topology Change Notification), a kind of BPDU, is sent by bridges towards the root bridge to notify changes in the topology, such as port up or port down.

TCP

Transmission Control Protocol

TCP-AO

TCP-AO MKT (Transmission Control Protocol Authentication Option). TCP-AO uses cryptographic algorithms to convert MKTs, which can be shared across connections, into unique traffic keys for each connection.

TCP-AO MKT

TCP-AO MKT (Transmission Control Protocol Authentication Option Master Key Tuple). TCP-AO uses cryptographic algorithms to convert MKTs, which can be shared across connections, into unique traffic keys for each connection.

TFTP

Trivial File Transfer Protocol

TLS

Transport Layer Security (TLS), the successor of the now-deprecated Secure Sockets Layer (SSL), is a cryptographic protocol designed to provide communications security over a computer network.

TLV

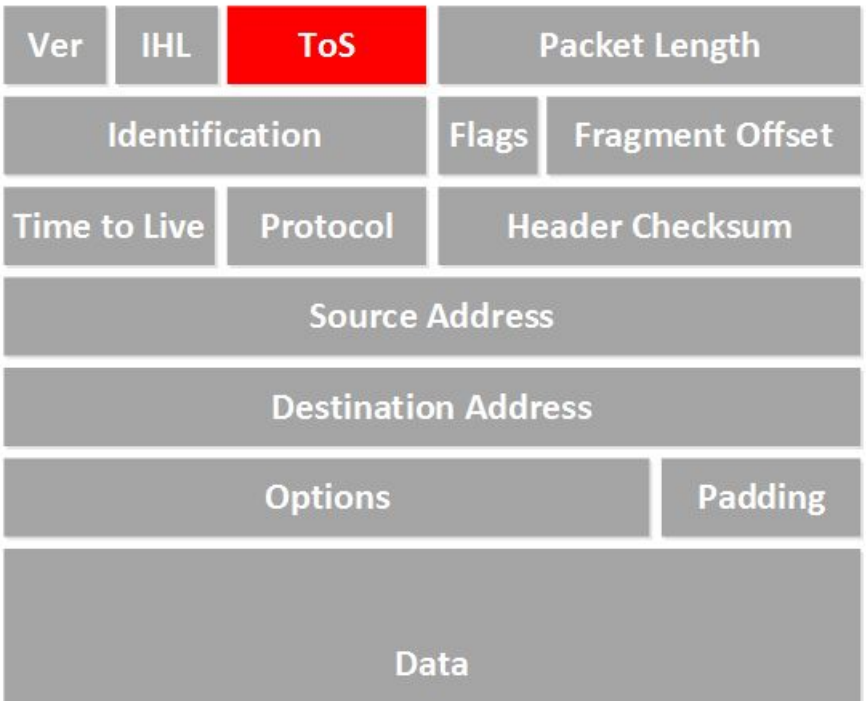
type, length, and value (TLV) traces

TN

Telnet (TN) is a networking protocol and software program used to access remote computers and terminals over the Internet or a TCP/IP computer network. Upon providing correct login and sign-in credentials, a user may access a remote system's privileged functionality. Telnet sends all messages in clear text and has no specific security mechanisms.

TOS

Type of Service (TOS). IP packets have a field called the Type of Service field (also known as the TOS byte).



TPID

Tag Protocol Identifier (TPID)

TTL

TTL (time to live). Under IP, TTL is an 8-bit field. In the IPv4 header, TTL is the 9th octet of 20. In the IPv6 header, it is the 8th octet of 40. The maximum TTL value is 255, the maximum value of a single octet. A recommended initial value is 64.

TX

Transmit

UAP

Uplink Access Port (UAP); when a tagged LLDP is enabled, the LLDP packets with destination address as 'nearest bridge address (01-80-c2-00-00-0E)' will be replicated for all S-Channels emulated over that UAP.

UART

UART (Universal Asynchronous Transmitter Receiver) is the most common protocol used for full-duplex serial communication.It is a single LSI (large scale integration) chip designed to perform asynchronous communication. This device sends and receives data from one system to another system.

UDP

User Datagram Protocol

UFD

Uplink failure detection (UFD)

URM

Unified Route Map (URM)

USM

USM stands for User based Security Model; USM (User based Security Model) and VACM (View-based Access Control Model) are the main features added as a part of the SNMPv3 specification. USM provides both encryption and authentication of the SNMP PDUs, while VACM specifies a mechanism for defining access policies for different users with different MIB trees.

UTC

Coordinated Universal Time (UTC); If the port is in the master state, the local clock is synchronized to an external source of time traceable to TAI (International Atomic Time) and UTC (Universal Coordinated Time) such as GPS (Global Positioning System) system.

UTP

Unshielded Twisted Pair (UTP) is a pair of wires that are twisted around each other to minimize interference. Ethernet cables are common example of UTP wires.

UUID

A Universally Unique IDentifier (UUID) is a 128-bit domain UUID unique to a MRP domain/ring. All MRP instances belonging to the same ring must have the same domain ID.

VACM

VACM stands for View-based Access Control Model); USM (User based Security Model) and VACM (View-based Access Control Model) are the main features added as a part of the SNMPv3 specification. USM provides both encryption and authentication of the SNMP PDUs, while VACM specifies a mechanism for defining access policies for different users with different MIB trees.

Varbind

A Variable Binding (Varbind) represents a set of Oid/Value pairs. Individual Variable Bindings are stored in the Vb class. Individual Variable Bindings are stored in the Vb class.
Create a variable binding and add the Object identifier in string format:
Vb vb = new Vb("1.3.6.1.2.1.1.1.0")
Create a variable binding and add the Object identifier in Oid format:
Oid oid = new Oid("1.3.6.1.2.1.1.1.0");
Vb vb = new Vb(oid);

VFI

Virtual Forwarding Interface (VFI)

VID

Management VLAN ID (VID)

VINES

Virtual Integrated Network Service (VINES)

VLAN

Virtual Local Area Network (VLAN) is a logical subgroup within a local area network that is created via software rather than manually moving cables in the wiring closet.

VPN

Virtual Private Network (*VPN*)

VRF

Virtual Routing and Forwarding (VRF). In IP-based computer networks, VRF is a technology that allows multiple instances of a routing table to co-exist within the same router at the same time. One or more logical or physical interfaces may have a VRF and these VRFs do not share routes; therefore, the packets are only forwarded between interfaces on the same VRF. VRFs are the TCP/IP layer 3 equivalent of a VLAN. Because the routing instances are independent, the same or overlapping IP addresses can be used without conflicting with each other.

VRRP

VRRP (Virtual Router Redundancy Protocol) is an election protocol that dynamically assigns responsibility for one or more virtual router(s) to the VRRP router(s) on a LAN, allowing several routers on a multi-access link to utilize the same virtual IP address. A VRRP router is configured to run the VRRP protocol in conjunction with one or more other routers attached to a LAN. In a VRRP setup, one router is elected as the virtual router master, and the other routers are acting as backups in case of the failure of the virtual router master. VRRP is designed to eliminate the single point of failure inherent in the static default routed environment

VSA

Vendor Specific Attribute (VSA)

WAN

A wide area network is a telecommunications network that extends over a large geographic area for the primary purpose of computer networking.

Web UI

Web User Interface (Web UI) is a control panel in a device presented to the user via the Web browser. Network devices such as gateways, routers, and switches typically have such control panel

that is accessed by entering the IP address of the device into a Web browser in a computer on the same local network.

WINS

Windows Internet Naming Service (WINS)

WRED

WRED (Weighted Random Early Detection) is a queueing discipline for a network scheduler suited for congestion avoidance. It is an extension to random early detection (RED) where a single queue may have several different sets of queue thresholds.

WRR

Weighted Round Robin (WRR) is one of the scheduling algorithms used by the device. In WRR, there is a number of queues and to every queue is assigned weight (*w*). In a classical WRR, the scheduler cycles over the queues, and when a queue with weight *w* is visited, the scheduler can send consequently a burst of up *to w* packets. This works well for packets with the same size.

XNS

Xerox Network Systems (XNS)

End User License Agreement (EULA)

TERMS AND CONDITIONS FOR SOFTWARE PROGRAMS AND EMBEDDED SOFTWARE IN PRODUCTS

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c) For greater certainty, Buyer agrees that (i) it will not directly or indirectly export, re-export or transfer Supplier products, documentation and services provided under these Terms and Conditions to any individual or entity in violation of any aforementioned Export Controls and Sanctions; (ii) it will not directly or indirectly export, re-export or transfer any such products, documentation and services to any country or region of any country that is prohibited by any applicable Export Controls and Sanctions or for any of the following end-uses, or in any of the following forms unless expressly authorized by any applicable government permit issued under or otherwise expressly permitted by applicable Export Controls and Sanctions:

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   ii) Technical information relating to the design, development or implementation of the cryptographic components, modules, interfaces, or architecture of any software; or

   iii) Source code or pseudo-code, in any form, of any of the cryptographic components, modules, or interfaces of any software.

d) Buyer confirms that it is not (i) listed as a sanctioned person or entity under any Export Controls and Sanctions list of designated persons, denied persons or specially designated

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In the event any Update or Upgrade includes an amended version of this EULA, Customer will be required to agree to such amended version in order to use the applicable iS5Com Materials and such amended EULA shall be deemed to amend the previously effective version of the EULA.

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– **4.1 Confidentiality**

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6) **TERM**

– **6.1 Term**

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– **6.2 Survival**

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7) **MISCELLANEOUS**

– **7.1 Miscellaneous**

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– **7.2 Subject to Change**

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Contents

INTRODUCTION

1. Introduction

Media Redundancy Protocol (*MRP*) is a networking protocol designed to implement redundancy and recovery in a ring topology. *MRP* is designed to react deterministically on a single failure on a switch in the MRP ring.

In an *MRP* ring, according to IEC 62439-2, one of nodes in the network takes on the role of the media redundancy manager (*MRM*), and the other nodes are the redundancy clients (*MRC*). The *MRM* initiates and controls the ring topology to react to network faults by sending control frames on one ring port over the ring and receiving them from the ring over its other ring ports.

MRM and *MRC* ring ports support three status: disabled, blocked, and forwarding. Disabled ring ports drop all the received frames. Blocked ring ports drop all the received frames except the MRP control frames. Forwarding ring ports forward all the received frames.

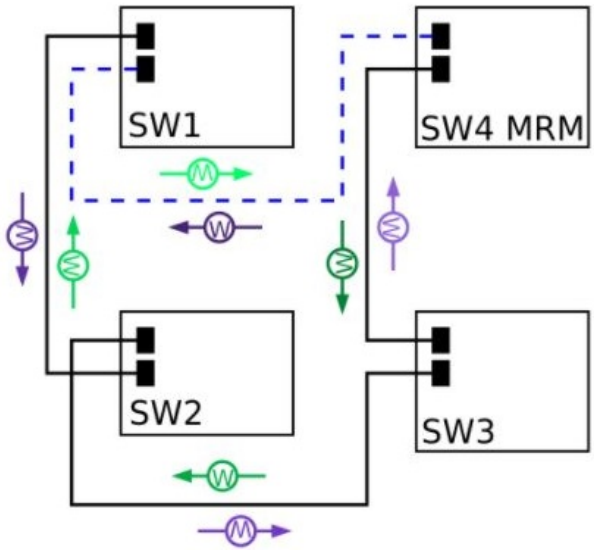
During normal operation, the ring works in the Ring-Closed state. In this state, as a loop prevention, one of the *MRM* ring ports is blocked, while the other is forwarding. Conversely, both ring ports of all *MRC*s are forwarding. Loops are avoided because the physical ring topology is reduced to a logical stub topology.

In case of failure, the network works in the Ring-Open state. For instance, in case of failure of a link connecting two *MRC*s, the *MRM* sets both of its ring ports to the forwarding state; the *MRC*s adjacent to the failure have a blocked and a forwarding ring port; the other *MRC*s have both ring ports forwarding. So, in the Ring-Open status, the network logical topology is a stub.

1.1. MRP Rings

The customer will be deploying *MRP* rings in their substations for fast failover and ease of configuration.

Ring-Closed MRP Ring

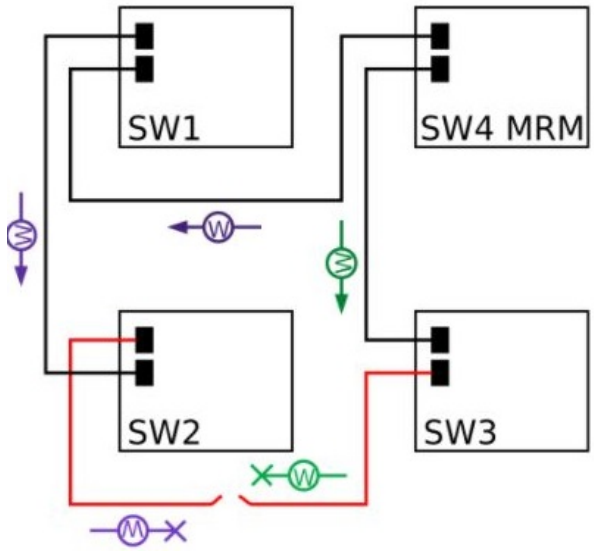


This picture above shows an *MRP* ring in a closed condition. The *MRM* switch is the *MRP* Media Redundancy Manager and it is the designated switch that controls the ring and prevents the network loop from forming. “W” are the watchdog packets that transit the network much like RSTP BPDUs. If there is a line failure, the W frames alert the *MRM* to put its redundant port to forwarding.

For the blocked port on the *MRM*, only watchdog frames are allowed to pass, and not data frames.

Ring-Open MRP Ring

The figure below shows the ring in an open state with the *MRM* engaged.



1.2. MRP Ring Size

A ring of 50 switches is currently supported.

1.3. Media Redundancy Automanager

To configure a Media Redundancy Automanager (*MRA*), the node or nodes select an *MRM* by election and configured priority value.

The MRA role is not an operational *MRP* role like *MRM* or *MRC*. It is only an administrative temporary role at a device startup. A node must transition to the *MRM* role or the *MRC* role after startup, and the *MRM* is selected though the manager voting process.

1.4. Purpose and Scope

This document describes the basic and advanced configuration tasks of switch's MRP.

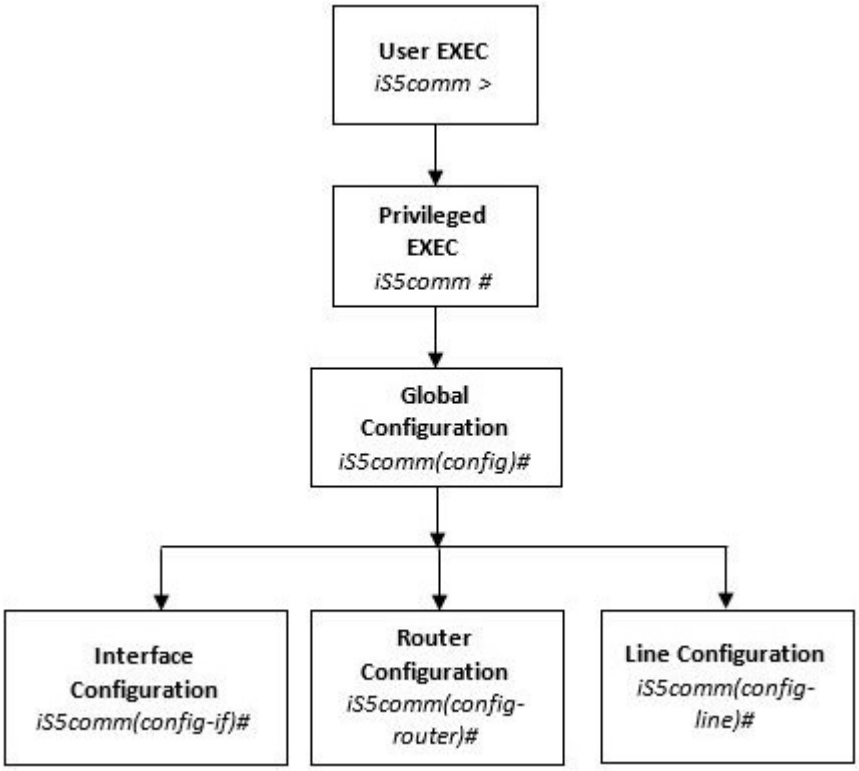
To add MRP functionality to the device platform with the simplest design, some understanding of the standards and its possible configurations is needed as a prerequisite.

1. CLI Command Modes

The *CLI* Modes are as follows.

The hierarchical structure of the command modes is as shown on the figure below.

Figure 1: CLI Command Modes


User EXEC
iS5comm >
Privileged EXEC
iS5comm #
Global Configuration
iS5comm(config)#
Interface Configuration
iS5comm(config-if)#
Router Configuration
iS5comm(config-router)#
Line Configuration
iS5comm(config-line)#

1.1. User Exec Mode

Prompt	Access method	Exit Method
`iS5comm>`	This is the initial mode to start a session.	logout

1.2. Privileged Exec Mode

Prompt	Access method	Exit Method
`iS5comm#`	The User EXEC mode command `enable` is used to enter the Privileged EXEC Mode	To return from the Privileged EXEC mode to User EXEC mode, the command `disable` is used.

1.3. Global Configuration Mode

Prompt	Access method	Exit Method
`iS5comm(config)#`	The Privileged EXEC mode command `configure terminal` is used to enter the Global Configuration Mode.	To return from the Global Configuration Mode to Privileged Mode, the command `exit` is used.

1.4. Interface Configuration Mode

Prompt	Access method	Exit Method
`iS5comm(config-if)#`	The Global Configuration mode command `interface <interface-type><interface-id>` is used to enter the Interface Configuration Mode.	To return from the Interface Configuration mode to Global Configuration Mode, the command `exit` is used. To exit from the Interface Configuration mode to Privileged EXEC Mode, the command `end` is used.

1.5. Port Channel Interface Configuration

Prompt	Access method	Exit Method
`iS5comm(config-if)#`	The Global Configuration mode command `interface port <port channel-id>` is used to enter the Port Channel Interface Configuration Mode.	To return from the Port Channel Interface Configuration mode to Global Configuration Mode, the command `exit` is used. To exit from the Port Channel Interface Configuration mode to Privileged EXEC Mode, the command `end` is used.

1.6. VLAN Interface Configuration Mode

Prompt	Access method	Exit Method
`iS5comm(config-if)#`	The Global Configuration mode command `interface vlan <vlan id>` is used to enter the VLAN Interface Configuration Mode.	To return from the VLAN Interface Configuration mode to Global Configuration Mode, the command `exit` is used. To exit from the VLAN Interface Configuration mode to Privileged EXEC Mode, the command `end` is used.

1.7. MRP Interface Configuration Mode

Prompt	Access method	Exit Method
`iS5comm(config-mrp)#`	The Global Configuration mode command `mrp ringid 1`s used to enter the MRP Interface Configuration Mode.	To return from the MRP Interface Configuration mode to Global Configuration Mode, the command `exit` is used. To exit from the MRP Interface Configuration mode to Privileged EXEC Mode, the command `end` is used.

1.8. UFD Configuration Mode

Prompt	Access method	Exit Method
`iS5comm(config-if)#`	The Global Configuration mode command `ufd group <group-id (1-65535)>` is used to enter the UFD Interface Configuration Mode.	To return from the UFD Configuration mode to Global Configuration Mode, the command `exit` is used. To exit from the UFD Configuration mode to Privileged EXEC Mode, the command `end` is used.

1.9. DHCP Pool Configuration Mode

Prompt	Access method	Exit Method
`iS5comm(dhcp-config)#`	The Global Configuration mode command **`(config)# ip dhcp pool`***`<pool number (1-2147483647)>`* is used to enter the UFD Interface Configuration Mode.	To return from the DHCP Pool Configuration Mode to Global Configuration Mode, the command `exit` is used. To exit from the DHCP Pool Configuration Mode to Privileged EXEC Mode, the command `end` is used.

1.10. Privilege Levels and Command Access

The following table will list out the commands available for the different user levels in Privileged and User Exec levels.

Command	First Param	Guest	Tech	Admin	Description
archive	download-sw		x	x	Downloads software image
clear					Clears the specified parameters
	alarm	x	x	x	Alarm related information
	au-message	x	x	x	Address update messages related information
	cfa	x	x	x	CFA module related information
	interfaces	x	x	x	Protocol specific configuration of the interface
	meter-stats	x	x	x	Specific configuration for meter

Command	First Param	Guest	Tech	Admin	Description
	poe	x	x	x	PoE related configuration
	screen	x	x	x	Screen information
	ip		x	x	IP related configuration
	line		x	x	Configures line information
	logs		x	x	Log information
	protocol		x	x	Clears the specified protocol counters
	spanning-tree		x	x	Spanning tree related configuration
	tcp		x	x	TCP related configuration
clock	set		x	x	Sets the system clock value
config-restore					Configures the restore option
	flash		x	x	File in flash to be used for restoration
	norestore		x	x	No configuration restore
	remote		x	x	Remote location configuration
configure	terminal		x	x	Configures the terminal
copy			x	x	Various copy options
debug					Configures trace for the protocol
	ip	x	x	x	IP related configuration
	show	x	x	x	Show mempool status
	sntp	x	x	x	SNTP related configuration
	crypto		x	x	Crypto related information
	cybsec		x	x	Cybsec related information
	dot1x		x	x	PNAC related configuration
	etherchannel		x	x	Etherchannel related information
	firewall		x	x	Firewall related configuration
	garp		x	x	GARP related configuration
	interface		x	x	Configures trace for the interface management
	lacp		x	x	LACP related configuration

Command	First Param	Guest	Tech	Admin	Description
	lldp		x	x	LLDP related configuration
	lns		x	x	LCD notification server
	nat		x	x	Network Address Translation related configuration
	np		x	x	NPAPI configuration
	ptp		x	x	Precision time protocol related configuration
	qos		x	x	QOS related configuration
	security		x	x	Security related configuration
	spanning-tree		x	x	Spanning tree related protocol configuration
	ssh		x	x	SSH related configuration
	tacm		x	x	Transmission and admission control related configuration
	vlan		x	x	VLAN related configuration
display firewall rules				x	Display firewall rules
dot1x	clear	x	x	x	Clear dot1x configuration
	initialize		x	x	State machine and fresh authentication configuration
	re-authenticate		x	x	Re-authentication
dump					Display memory content from the given memory location
	mem		x	x	Dump memory
	que		x	x	Show the queue related information
	sem		x	x	Show the semaphore related information
	task		x	x	Show the task related information
egress bridge			x	x	
end			x	x	Exit to the privileged Exec (#) mode

Command	First Param	Guest	Tech	Admin	Description
erase			x	x	Clears the contents of the startup configuration
exit		x	x	x	Logout
factory reset				x	Reset to factory default configuration
factory reset	users			x	Reset all users on switch
firmware			x	x	Upgrades firmware
generate	tech		x	x	Generate the tech report of various system resources and protocol states for debugging
help		x	x	x	Displays help for commands
ip	igmp snooping clear counters	x	x	x	Clears the IGMP snooping statistics
	clear counters		x	x	Clear operation
	dhcp		x	x	DHCP related configuration
	pim		x	x	PIM related configuration
	ssh		x	x	SSH related information
listuser			x	x	List the user, mode and groups
lock			x	x	Lock the console
logout		x	x	x	Logout
memtrace			x	x	Configures memtrace
no ip					IP related information
	dhcp		x	x	DHCP related configuration
	ssh		x	x	SSH related information
no debug					Configures trace for the module
	ip	x	x	x	Stops debugging on IGMP or PIM
	sntp	x	x	x	Stops debugging on SNTP related configurations
	additional options...		x	x	Stops debugging for other options
ping					

Command	First Param	Guest	Tech	Admin	Description
	A.B.C.D	x	x	x	Ping host
	ip dns host name	x	x	x	Ping host
	ip A.B.C.D	x	x	x	Ping host
	vrf	x	x	x	Ping vrf instance
readarpfromHardware ip	A.B.C.D		x	x	Reads the arp for the given IP
readregister			x	x	Reads the value of the register from the hardware
release dhcp			x	x	Performs release operation
reload			x	x	Restarts the switch
renew dhcp			x	x	Performs renew operation
run script			x	x	Runs CLI commands
shell				x	Shell to Linux prompt
show		x	x	x	Shows configuration or information
sleep		x	x	x	Puts the command prompt to sleep
ssl				x	Configures secure sockets layer related parameters
snmpwalk mib					Allows the user to view Management Information Base related configuration.
	name	x	x	x	
	oid	x	x	x	
traceroute					Traces route to the destination IP
	A.B.C.D		x	x	
write			x	x	Writes the running-config to a flash file
writeregister			x	x	writes in the specified register

1.11. Configuration Terminal Access

The Guest user level does not have access to the configuration terminal.

The Administration level has access to all commands in the configuration terminal.

The Technical level has access to all commands in the configuration terminal with the following exceptions listed below.

- bridge-mode
- enableuser
- mst
- password
- traffic

1. CLI Document Convention

To provide a consistent user experience, this *CLI* document convention adheres to the Industry Standard *CLI* syntax.

In addition, the font and format are updated to show *DITA* / Structured Framemaker 2019 layout.

Convention	Usage	DESCRIPTION
Italics	User inputs for *CLI* command	`configure terminal`
Font as shown	Syntax of the *CLI* command	`configure terminal`
< >	Parameter inside the brackets < > indicate the Input fields of syntax	`<integer (100-1000)>`
[ ]	Parameter inside [ ] indicate optional fields of syntax	`show split-horizon [all]`
{ }	Grouping parameters in the syntax	`ip address <ip-address> [secondary {node0 | node1}]`
|	Separating grouped parameters in the syntax	`set http authentication-scheme {default| basic| digest}`

Convention	Usage	DESCRIPTION
Font & format as shown	Example & CLI command outputs	iS5comm# show split-horizon interface 1 Ingress Port VlanId StorageType Egress List ========== ====== ========== ========== Gi0/1 - Volatile Gi0/2,Gi0/3,Gi0/6
Note	Notes	**NOTE:** All commands are case-sensitive

2. MRP Design

Media Redundancy Protocol (*MRP*) is a networking protocol designed to implement redundancy and recovery in a ring topology, and redundant interconnection of multiple *MRP* rings. *MRP* is designed to react deterministically on a single failure of an interswitch link or when switching the *MRP* ring or interconnection topology.

2.1. Redundancy Summary

Redundancy within the network considers the presence of more network elements (switches, link) than necessary operation, in order to prevent the loss of communication caused by a failure. To implement this, there is more than one physical path between any two nodes. As per the IEC 61918 specified ring topology, every switch has a redundant connection (link) into the network. The redundant links are not required for a failure-free/normal operation of the network; however, in case of a failure, these redundant links are used to prevent the breakdown of the network. The disadvantage of ring topology is that it can introduce a “packet loop” that creates broadcast storms in the network.

Spanning Tree protocols (*STP*), such as *RSTP*, specify a method for providing media redundancy while preventing the undesirable packet loop in a network. (i.e. *RSTP* was developed to detect and eliminate the physical loop in the network). Also, in case of a failure in the network, a topology change notification is sent out to create a different safe path.

Although *STP* is effective enough for many networks, it takes longer time for reconvergence in case of failure. This is not good enough for mission-critical industrial Ethernet applications.

To overcome the limitations of *RSTP*, *MRP* protocol was developed. *MRP* uses mechanisms similar to *RSTP* (e.g., deleting forwarding database after reconfiguration, setting ports into blocking or forwarding mode), but it takes lesser time for reconvergence in case of failure. Shown below is the comparison between *MRP* and *RSTP*.

Table 1: Comparison between MRP and RSTP

	MRP	RST
Topology	Ring	Any
Number of switches	50+	Maximum of 40 Switches
Recovery time	Recovery time in case of a failure can run into Less than 200ms	Recovery time in case of a failure can run into seconds depending on the topology and size of the network.
Configuration	Simple	Medium

2.2. MRP Function

It is the *MRM*'s responsibility to monitor the ring topology. During normal ring operation (i.e., no link or node failure in the ring topology), the *MRM* disconnects one of its ring ports, so that the ring topology becomes 'loop free' from a communication point of view. As soon as the ring is open due to the failure of a node, and the data communication is broken, the *MRM* reconfigures the data paths within 200 ms by enabling the disconnected ring port and creating a new loop free topology.

Figure 1: MRP Normal Operation

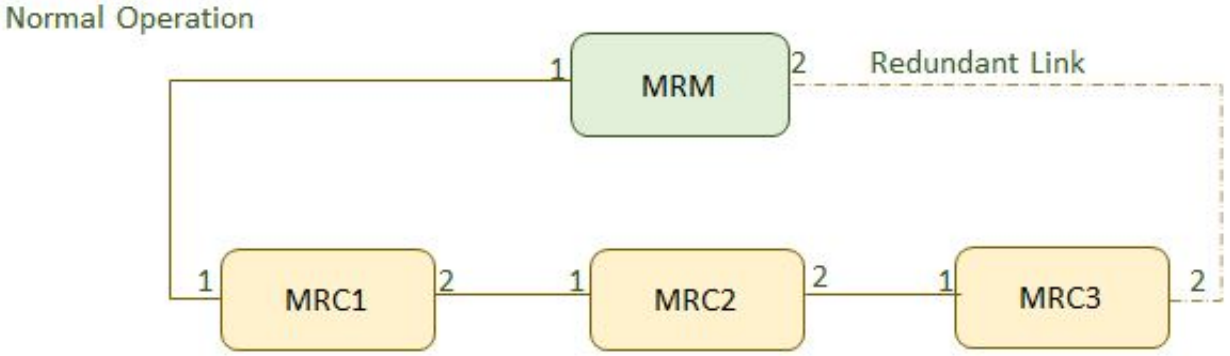
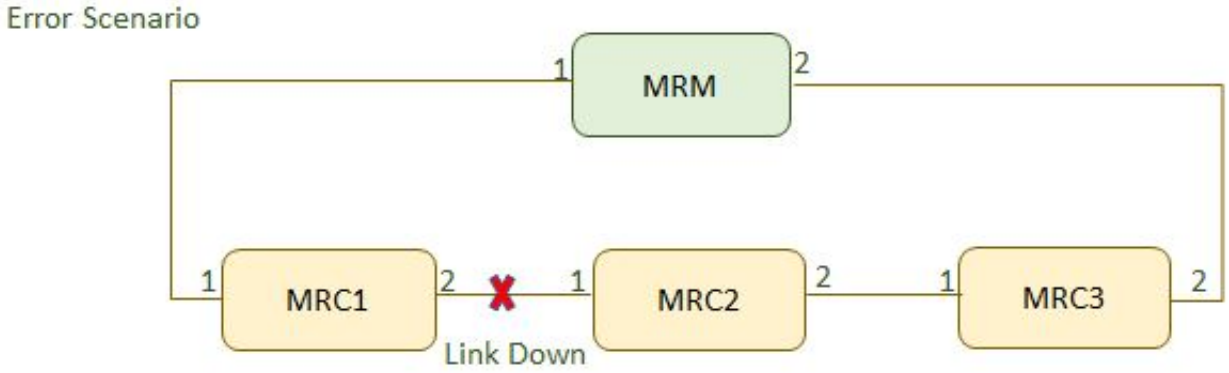


Figure 2: MRP Error Scenario



2.3. MRP Ring Port States

An *MRP* ring is set up via dedicated ring ports. An *MRP* Interconnection is set up via dedicated interconnection ports.

By default Ring / Interconnect port can be either linkup/down state. If a ring port or interconnection port is in the state LINK_UP, *MRP* will modify the port states of the ring and interconnection ports to prevent loops in a ring or interconnection topology.

A ring port or interconnection port may be assigned one of the following states.

- BLOCKED: indicates that all frames are dropped except:

  - *MRP* topology change frames and *MRP* test frames from a *MRM*,
  - *MRP* link change frames from an *MRC*,
  - *MRP* Interconnection topology change from a *MIM*,
  - *MRP* interconnection link change from a *MIC*, and
  - frames from other protocols that also define to pass blocked(2) ports.

- FORWARDING: indicates that all frames are passed through according to the forwarding behavior of IEEE 802.1D.
- DISABLED: indicates that all frames are dropped, but it is not set by *MRP* though.

2.4. MRP Frames

MRP information is sent in the form of an Ethernet frame (*MRP* Frame) with Type–length–value (TLV) structures, thus allowing organizationally specific information.

MRP messages are always sent to the specific *MAC* address with the OUI = 00-15-4E and EthType 0x88E3. The following multicast *MAC* addresses are used for basic MRP and MRP Interconnect.

Table 2: Multicast MAC Addresses used for basic MRP and MRP Interconnect

MAC	Purpose
01-15-4E-00-00-01	It is used for monitoring the ring state via test frames.
01-15-4E-00-00-02	It is used to indicate link changes from *MRC* to other ring members, and to indicate ring topology changes from *MRM* to all *MRC* via control frames.
01-15-4E-00-00-03	It is used for monitoring the interconnection state via test frames.
01-15-4E-00-00-04	It is used to indicate link changes from *MIC* to the *MIM*, poll the *MIC* status, and indicate interconnection topology changes from *MIM* to all *MRM* via control frames.

As these multicast *MAC* addresses are not within the port local bridge group address area 01-80-601 C2-00-00-xx defined in [IEEE 802.1Q], received frames with these multicast addresses shall be propagated to all Layer 2 connected ports when *MRP* is off.

A summary of an *MRP* frame is shown below.

Table 3: Summary of MRP Frame (Sheet 1 of 2)

PRE	SFD	DstMac	SrcMac	EhtType	MRP Data	PAD	FCS
7 bytes	1 byte	6 bytes	6 bytes	2 bytes	46-1500 bytes		4 bytes

Table 3: Summary of MRP Frame (Continued) (Sheet 2 of 2)

PRE	SFD	DstMac	SrcMac	EhtType	MRP Data	PAD	FCS
		01-15-4E-00-00-01/01-15-4E-00-00-02/01-15-4E-00-00-03/01-15-4E-00-00-04	Port Mac Address	0x88E3			

2.5. Normal Operation: Ring Closed

To detect errors in the network, the *MRM* sends MRP_Test frames on both of its ring ports. These frames run through the ring in both directions until they arrive at the other ring port of the *MRM*. These MRP_Test frames are marked with a special MAC address and forwarded by the MRCs only to the opposite ring ports. They are sent periodically every MRP_Test default interval (20 ms by default). If the MRP_Test frames come back to both ends of the *MRM*, the ring is detected as defect-free (ring closed) and the *MRM* blocks the loop. This is done by changing the state to BLOCKED at one of the ring ports in the *MRM* and the other as FORWARDING as shown in Figure 2 below. On this BLOCKED port only test frames for supervising the ring (MRP_Test frames) are sent. Data frames are sent by the *MRM* only on the port in FORWARDING state.

Figure 3: MRP Normal Operation with Traffic Shown

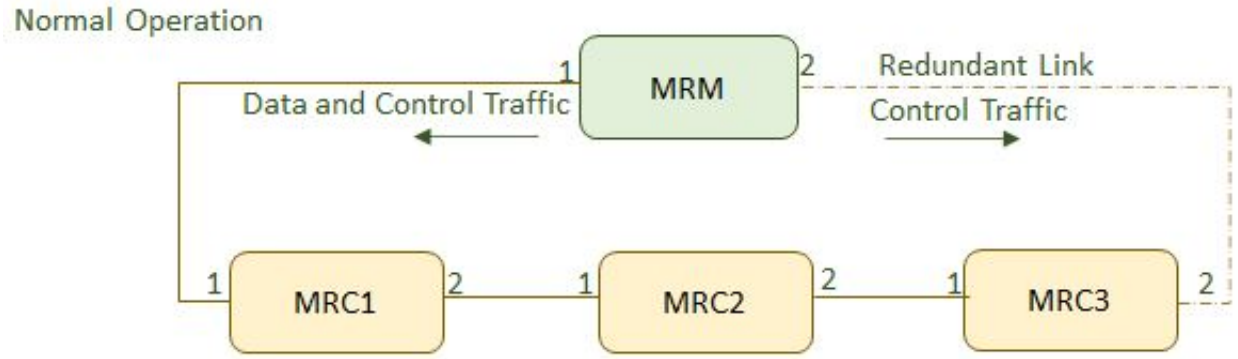


Table 4: MRP Normal Operation

	Ring Port 1	Ring Port 1
MRM	Forwarding	Blocked
MRC1	Forwarding	Forwarding
MRC2	Forwarding	Forwarding
MRC3	Forwarding	Forwarding

NOTE: A blocked port can transmit and receive only the control traffic. Hence, MRM transmit the data traffic only via Ring Port 1.

2.6. Failure Detection: Ring Open

If MRP_Test frames (typically 3 frames in sequence) are not received by the MRM, the ring topology is considered as interrupted. So it takes 60 ms to detect a failure in the ring. To change the topology in the whole ring, all *MRC*s and the *MRM* have to clear their Filtering Data Base (FDB)s at the same time as the redundant port is changing state from BLOCKED to FORWARDING to keep the network consistent. The *MRM* sends 3 MRP_TopologyChange messages with 10ms delay into the ring with the indication that the topology has changed. The blocked port on the *MRM* changes the state from BLOCKING to FORWARDING. Every *MRC* receiving MRP_TopologyChange indications is supposed to clear its FDB at the MRP_TOPchgT time. Afterwards, *MRC*s have to build again the FDB based on the new topology.

Figure 4: MRP Failure Detection

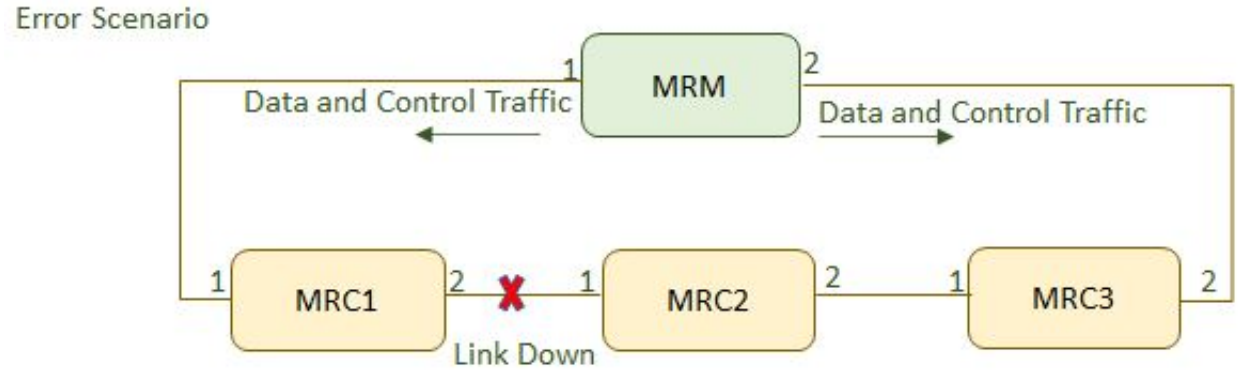


Table 5: MRP Normal Operation

	Ring Port 1	Ring Port 1
MRM	Forwarding	Forwarding
MRC1	Forwarding	Link Down
MRC2	Link Down	Forwarding
MRC3	Forwarding	Forwarding

NOTE: The ring is open due to a link fault between MRC1 and MRC2. *MRM* ports (1 & 2) are in forwarding state and transmit and receive both data and control traffic.

The time between detecting a ring interruption and restoring a new data structure is referred to as the recovery time. The recovery time has a maximum value of 200 ms. As soon as the fault is recovered in the network, the redundancy manager disconnects its ring port again and informs the clients of the change.

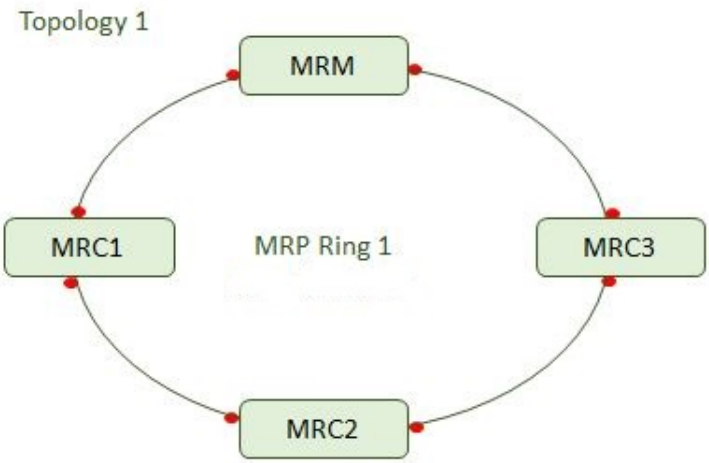
3. MRP Configurations

There are 4 *MRP* Configurations as shown below.

3.1. MRP Configuration 1

The following figures show the basic *MRP* Configuration.

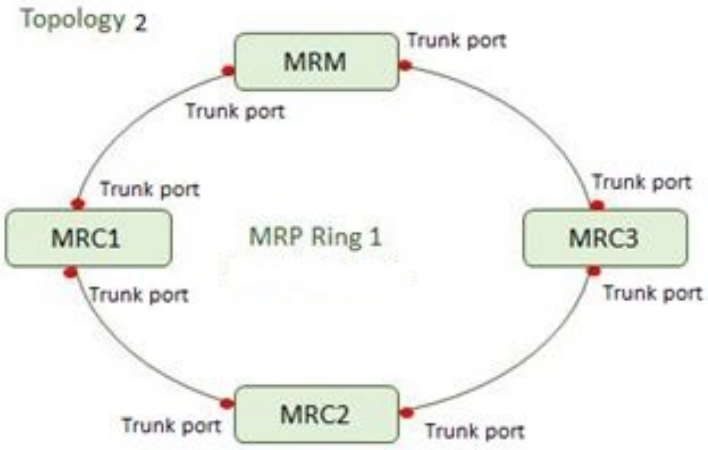
Figure 1: Topology 1



MRP Configuration 2

It is same as Configuration 1 but with Trunk ports and VLAN assignment.

Figure 2: Topology 2



In a configuration with 2 interconnected rings and when providing multiple instance support, the user configures up to 2 rings on a device. Each *MRP* instance can be a media redundancy manager (*MRM*) or media redundancy client (*MRC*), or Media Redundancy Automanager (*MRA*). Support for configuring multiple *MRP* rings is available through the CLI / SNMP and Web UI with the following configuration rules.

- If more than one *MRC* or *MRM* or *MRA* instances are active on one node and connecting the related rings connected to the ring ports of this node, there will be no other nodes in the network connecting the same rings over its MRC or MRM or MRA instances.

Below are the possible user cases for supporting multiple instances:

Figure 3: Topology 3 - Single Coupling Manager

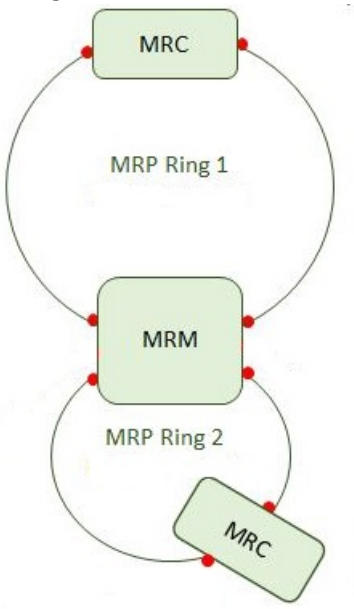


Figure 4: Topology 4- Single Coupling Client

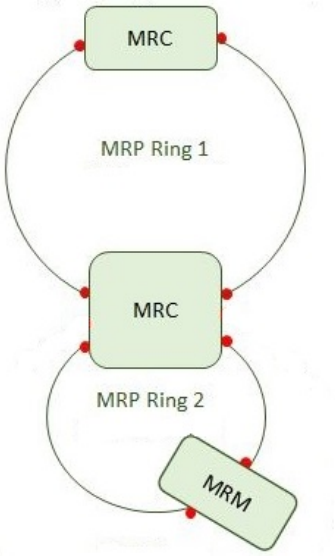
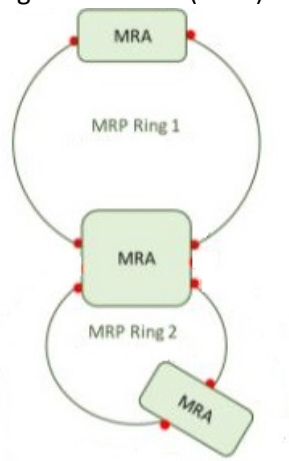


Figure 5: Topology 5- Single Coupling Manager and Client (MRA)



MRP Configuration 3

This is *MRP* ring single coupling configuration with two interconnected rings.

Single coupling is performed when a port on a switch in the *MRP* ring is connected to a port on a switch in a *RSTP* ring/network. The single coupling is always possible as for the *RSTP*-Bridge the connection to the MRP-Bridge is, seen from *RSTP* point of view, like an “edge” connection, i.e. the connecting port of the bridge of the *RSTP* controlled subnet area will migrate to an edge port. An edge port of an *RSTP* enabled bridge does not expect and process *RSTP*-BPDUs.

The picture below shows how a *MRP* ring is connected to an *RSTP* ring using single coupling.

Figure 6: MRP Configuration 3 - Single Coupling

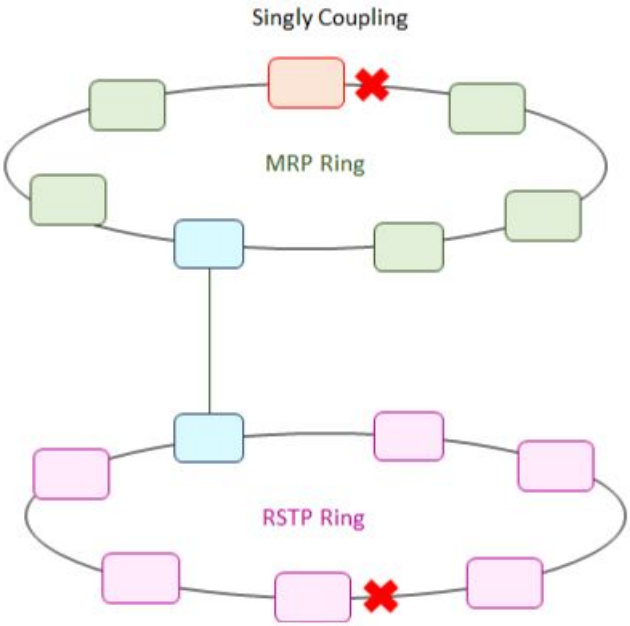


Figure 7: MRP Configuration 3 - MRP Ring Node Details

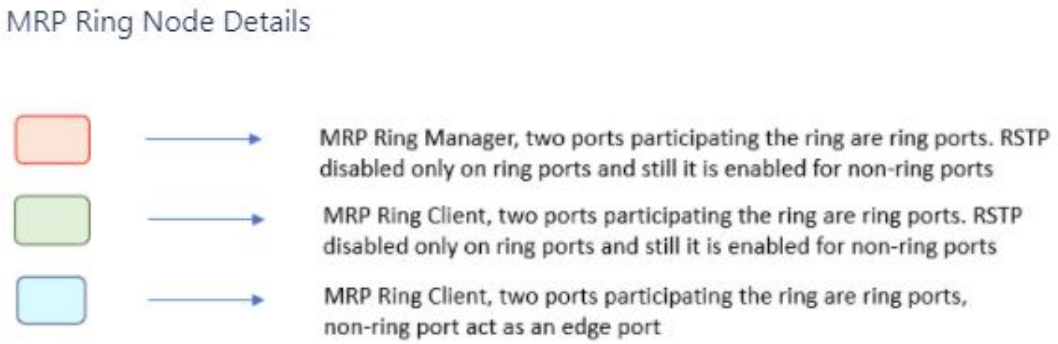
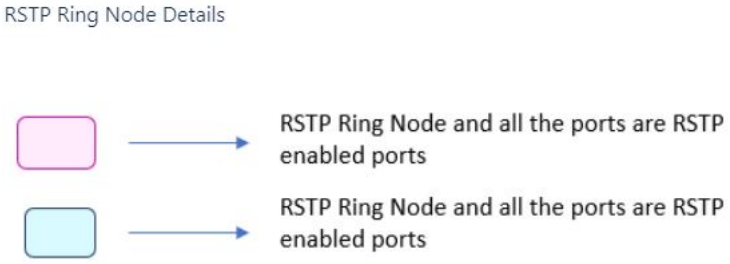


Figure 8: MRP Configuration 3 - RSTP Ring Node Details



MRP Configuration 4

Configuration 4 is *RSTP* & *MRP* interconnection dual homing setup (single device dual homing)

During Dual Homing (Single Switch Coupling), the redundant coupling is performed using 2 ports on a switch in the *MRP* ring/network, each port is connected to a port on 2 different switches in a *RSTP* ring/network. One connection is the primary connection, and the other is the stand-by connection.

The dual homing application can be solved by enabling *RSTP* on the non-ring ports, and only on the non-ring ports, of the connecting *MRP*- Bridge. This solution is only possible if there is only one connecting bridge on the *MRP*- network involved.

Figure 9: MRP Configuration 3 - Dual Homing

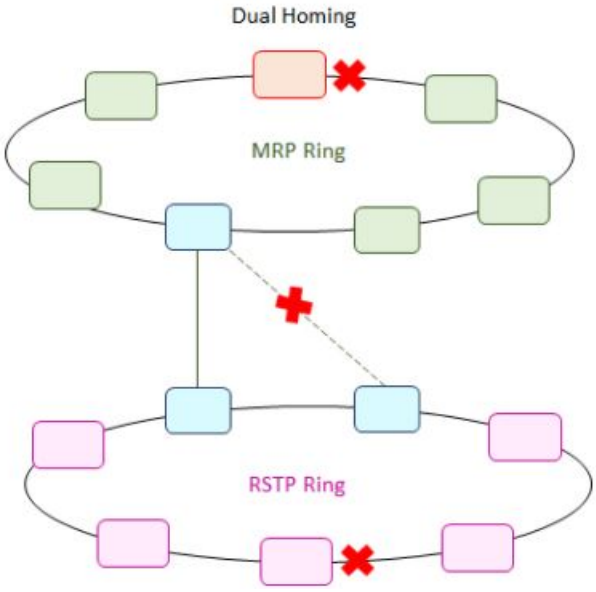


Figure 10: MRP Configuration 3 - MRP Ring Node Details

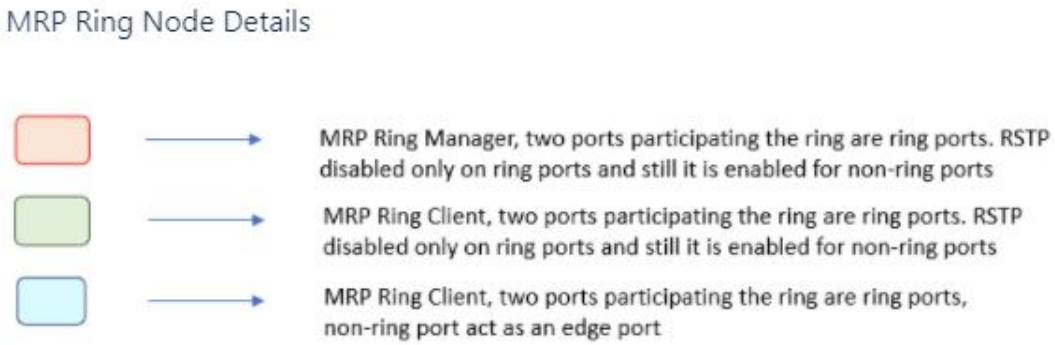
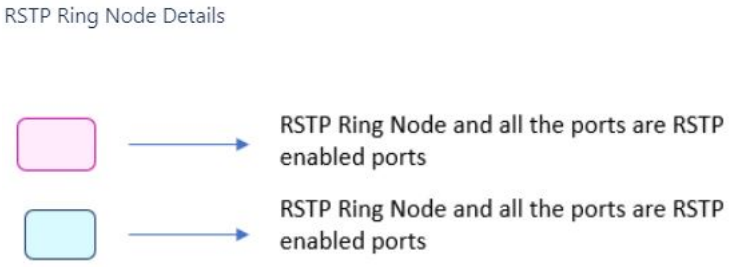


Figure 11: MRP Configuration 3 - RSTP Ring Node Details



4. MRP Interconnect

4.1. What is MRP Interconnect

As per IEC 62439-2, it is possible to redundantly interconnect two or more MRP rings via the Media Redundancy Protocol (*MRP*) Interconnection Protocol. An *MRP* Interconnection setup consists at a minimum of two rings and two redundant interconnection links between these rings. The redundant interconnection links are provided by four dedicated devices supporting the *MRP* Interconnection protocol. The roles of these four devices must be one Media Redundancy Interconnection Manager (MIM) and three Media Redundancy Interconnection Clients (MIC). All four devices must additionally take one of the basic operational MRP roles, MRC or MRM, as they are also part of the MRP rings. MRP Interconnect protocol used either of the below two modes to find the failure in the network among these 4 devices.

4.2. LC mode and RC mode

MRP Interconnect has two modes: LC mode (CFM-based) and RC mode (MRP_InTest frames).

In Ring Check (RC) mode, the MRP Interconnection protocol uses sending and receiving of circling MRP Interconnection test frames (MRP_InTest frames) to derive the interconnection state.

In Link Check (LC) mode, the MRP Interconnection protocol uses link detection mechanisms (e.g. CFM) between coupling devices to derive the interconnection state. LC mode has the advantage of restricting the interconnection test frame load only to the interconnection links, whereas RC mode has the advantage of deloading the MICs from interconnection test frame processing.

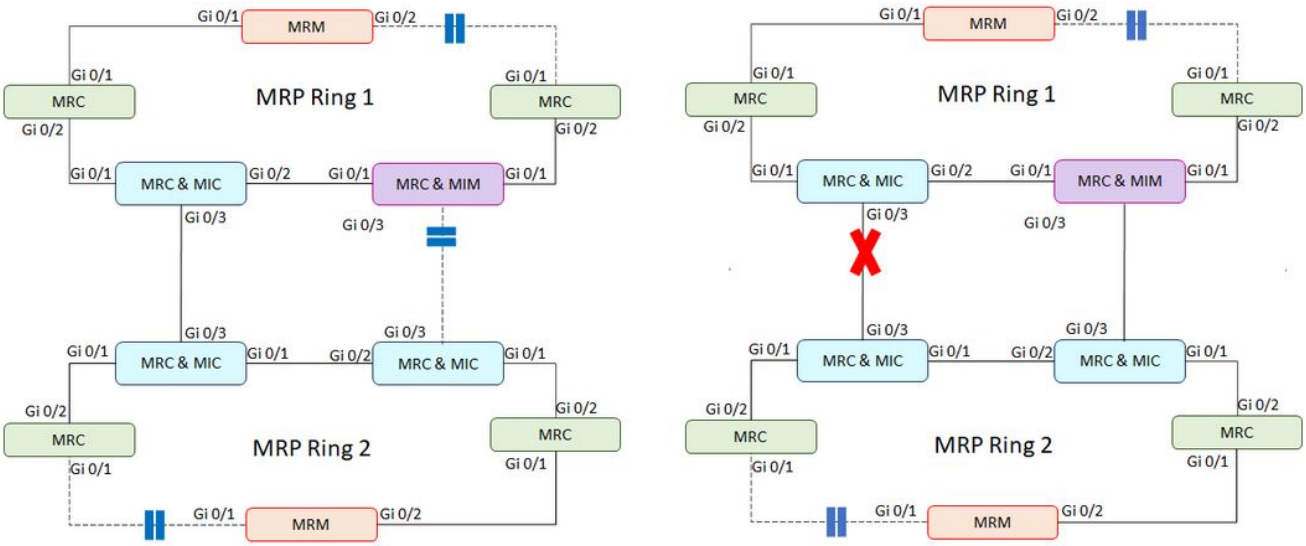
The selection of the mode has to be made in accordance with the requirements of the application.

For MRP Interconnect, we support RC mode.

4.3. MRP Interconnect Function

The following figure explains the basic functionality of the MRP Interconnection protocol.

Figure 1: Basic Functionality of the MRP Interconnection Protocol



4.4. MIM and MIC Port States

Media Redundancy Interconnection Manager (MIM)

The Media Redundancy Interconnection Manager (MIM) shall control its interconnection port state as follows by:

- Directly reacting only on interconnection port link change notifications from the MICs and from its own interconnection port (LC mode); or
- Reacting on MRP_InTest frames (RC mode);
- Setting its interconnection port in BLOCKED state if:
  - it is in LC mode and receives interconnection port link up notifications from its own interconnection port and from the MICs in the interlink connection (this means that the interconnection topology is closed—see the figure above);
  - it is in RC mode and receives its own MRP_InTest frames (this means that the interconnection topology is closed—see the figure above).
- Setting the interconnection port in FORWARDING state if:
  - it is in LC mode and receives an interconnection port link down notification from at least one of the MICs in the interlink connection (this means that the interconnection topology is open).
  - it is in RC mode and does not receive its own MRP_InTest frames within a configured time according to MRP_IN_TSTdefaultT and MRP_IN_TSTNRmax (this means that the interconnection topology is open).

Synchronization between MIM and MIC

The following mechanism supports synchronization between MIM and MIC during interconnection topology changes.

1) The MIM shall indicate changes in the interconnection topology state to the MICs, and to the MRMs in the connected MRP rings, by means of MRP_InTopologyChange frames.
2) When it is in LC mode, the MIM shall, after startup and after recognition of a link up at its interconnection port, issue a MRP_InLinkStatusPoll frame at its ring ports to poll the status of the redundant interlink connection from the MICs.
3) When it is in RC mode, the MIM shall, after startup and after recognition of a link up at its interconnection port, cyclically send and receive MRP_InTest frames at its ring ports and at its interconnection port to detect the status of the interconnection topology. When a transition to open or close interconnection topology is detected, then the MIM shall send the MRP_InTopologyChange frames through both ring ports and through its interconnection port to the MICs and to the MRMs to initiate the interconnection topology change.
4) If the MIC receives an MRP_InTopologyChange frame, then the MIC shall, after recognition of a link up at its interconnection port, change the port state of its interconnection port to FORWARDING.
5) If the MRMs receive a MRP_InTopologyChange frame, then the MRMs shall send MRP_TopologyChange frames at both ring ports, with the delay, after which all MRCs and MICs in the connected MRP rings will clear their Filtering Database (FDB).
6) The MIM shall not forward its own MRP_InTest frames between the ring ports and its interconnection port. The MIM shall forward MRP_InLinkChange frames, MRP_InLinkStatusPoll frames and MRP_InTopologyChange frames received on one ring port to the other ring port and vice versa.
7) The MIM shall process MRP_InLinkChange frames and MRP_InTopologyChange frames. The MIM shall not forward MRP_InLinkChange frames, MRP_InLinkStatusPoll frames and MRP_InTopologyChange frames if the MIM received these frames at its interconnection port.
8) Each MIC shall send the configured delay in MRP_Interval to the MIM in the MRP_InLinkUp and MRP_InLinkDown frames to tell the MIM after which time the MIC will change its interconnection port state from BLOCKED to FORWARDING (MRP_InLinkUp frame) or from FORWARDING to BLOCKED (MRP_InLinkDown frame).
9) Each MIM shall support BLOCKED port state at the interconnection port.

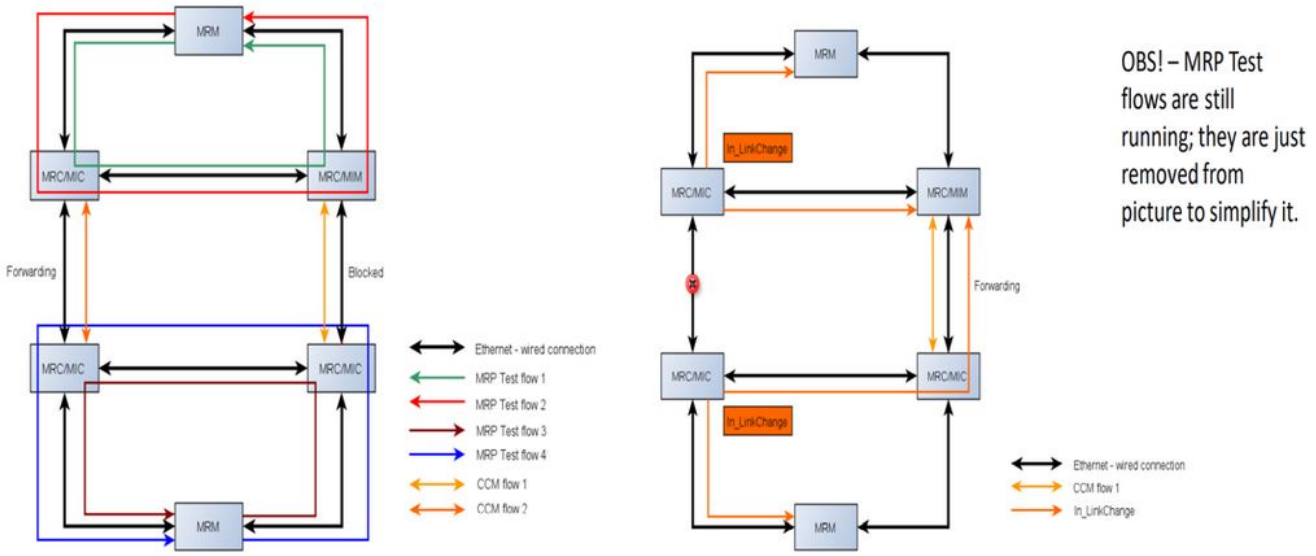
Media Redundancy Interconnection Client (MIC)

1) The interconnection port of the MIC shall be connected to the interconnection port of a MIM in another MRP ring, and the interconnection port of another MIC in the same ring shall be connected to the interconnection port of a MIC in this other MRP ring, thereby forming a MRP interconnection topology as shown in the figure above.
2) Each MIC shall forward MRP_InTest frames received on one ring port to the other ring port and to the interconnection port. Each MIC shall forward MRP_InTest frames received on the interconnection port to both ring ports.

3) If the MIC detects a failure or recovery of the interconnection port link, the MIC shall notify the change by sending MRP_InLinkChange frames through both of its ring ports. Each MIC shall forward MRP_InLinkChange frames received on one ring port to the other ring port and vice versa.
4) Each MIC shall forward MRP_InLinkChange frames received on one of the ring ports to the interconnection port. Each MIC shall forward MRP_InTopologyChange frames received on one ring port to the other ring port and vice versa.
5) Each MIC shall process MRP_InTopologyChange frames. It shall, after recognition of a link up at its interconnection port, change the port state of its interconnection port to FORWARDING.
6) After receiving a MRP_InLinkStatusPoll frame from the MIM, each MIC shall respond with a MRP_InLinkChange status frame informing about its current interconnection port link status.
7) Each MIC shall support BLOCKED port state at the interconnection port.

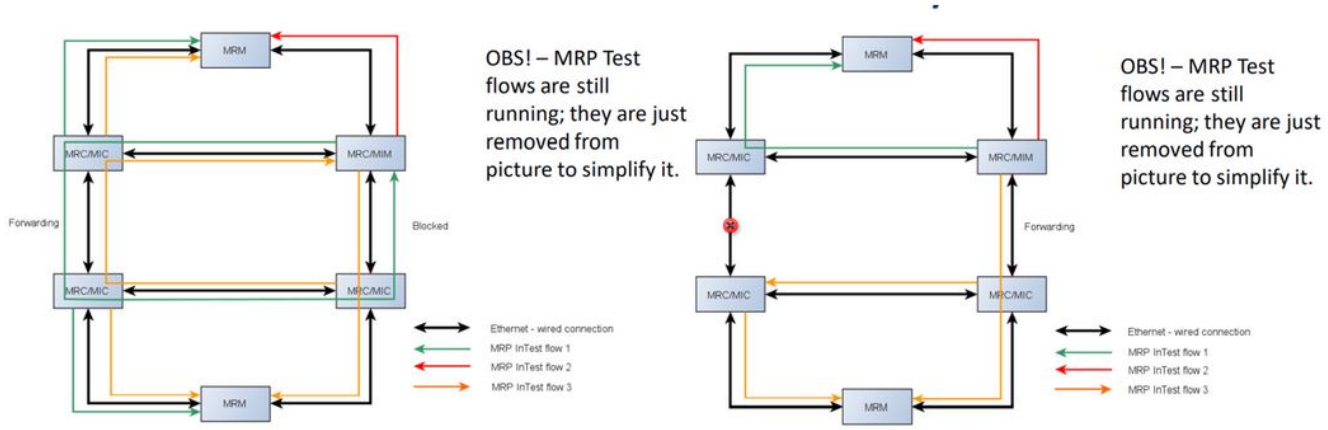
Working Principle of MRP Interconnect Mode in LC Mode

Figure 2: Working Principle of MRP Interconnect mode in LC Mode (Interconnect Close & Open Scenario)



Working Principle of MRP Interconnect mode in RC Mode

Figure 3: Working Principle of MRP Interconnect mode in RC Mode (Interconnect Close & Interconnect Open Scenario)



Roles of MIM, MIC, MRM, and MRC

Figure 4: Roles of MIM, MIC, MRM, and MRC

		PDU Types			
		In Test (Both in LC & RC Mode)	In Topology (Both in LC & RC Mode)	In LinkUp/Down (in LC Mode Only)	In LinkStatus Poll (in LC Mode Only)
ROLE	MIM	Generate & Terminate	Generate & Terminate	Trap & Terminate	Generate & Terminate
	MIC	Forward	Forward	Generate & Forward	Terminate & Forward
	MRM	Terminate	Trap	Terminate	Terminate
	MRC	Forward	Forward	Forward	Forward

4.5. Default MRP Interconnect Profiles

The Default MRP Interconnect Profiles are as follows.

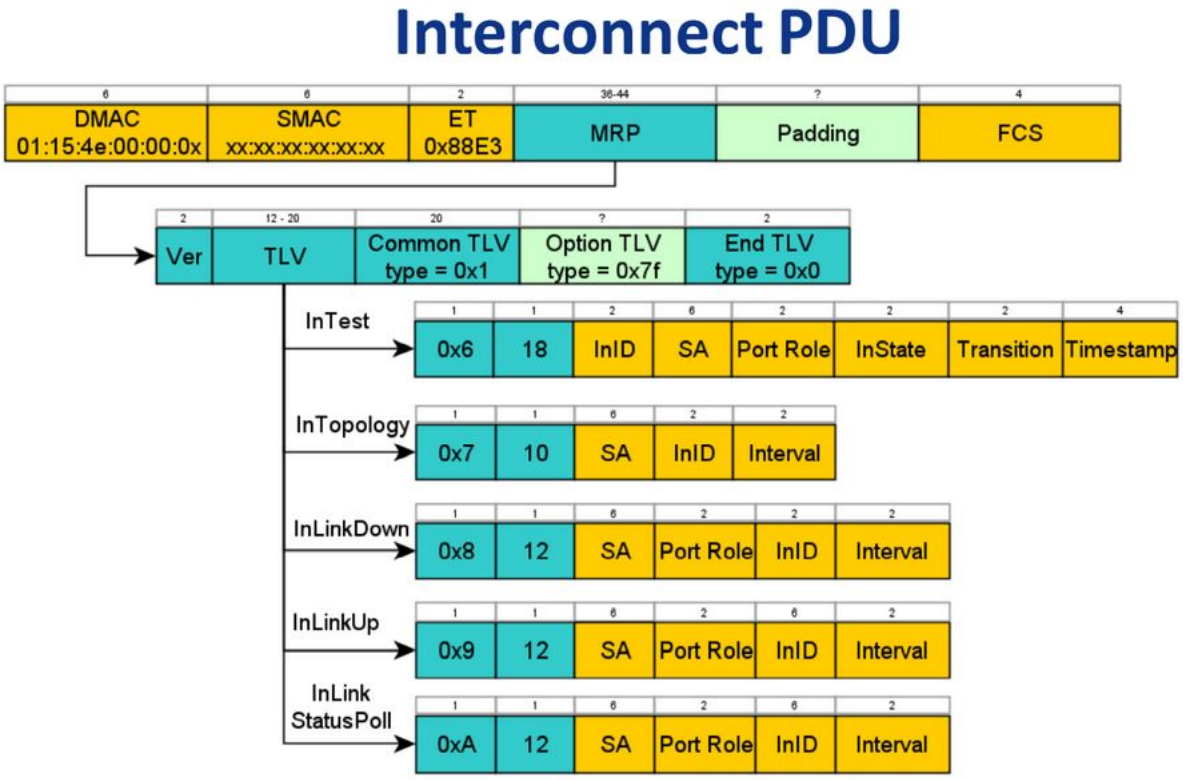
Figure 5: MRP Interconnect Profiles

Interconnect profiles

		Profile		
		500ms	200ms	Meaning
Parameter	In Topology	20ms	10ms	In Topology Change interval
	In Topology Cnt	3	3	In Topology Change repeat count
	In Test default	50ms	20ms	In Test default interval
	In Test Max	8	8	In Test Max miss count
	In LinkStatusPoll	20ms	20ms	In LinkStatusPoll interval
	In LinkStatusPoll Cnt	8	8	In LinkStatusPoll count
	In LinkDown	20ms	20ms	In Link Down interval
	In LinkUp	20ms	20ms	In Link Up interval
	In Link Cnt	4	4	In Link Change repeat count

4.6. MRP Interconnect frames

Figure 6: MRP Interconnect PDUs



4.7. MRP Interconnect Use Cases

Figure 7: MRP Interconnect Use Cases

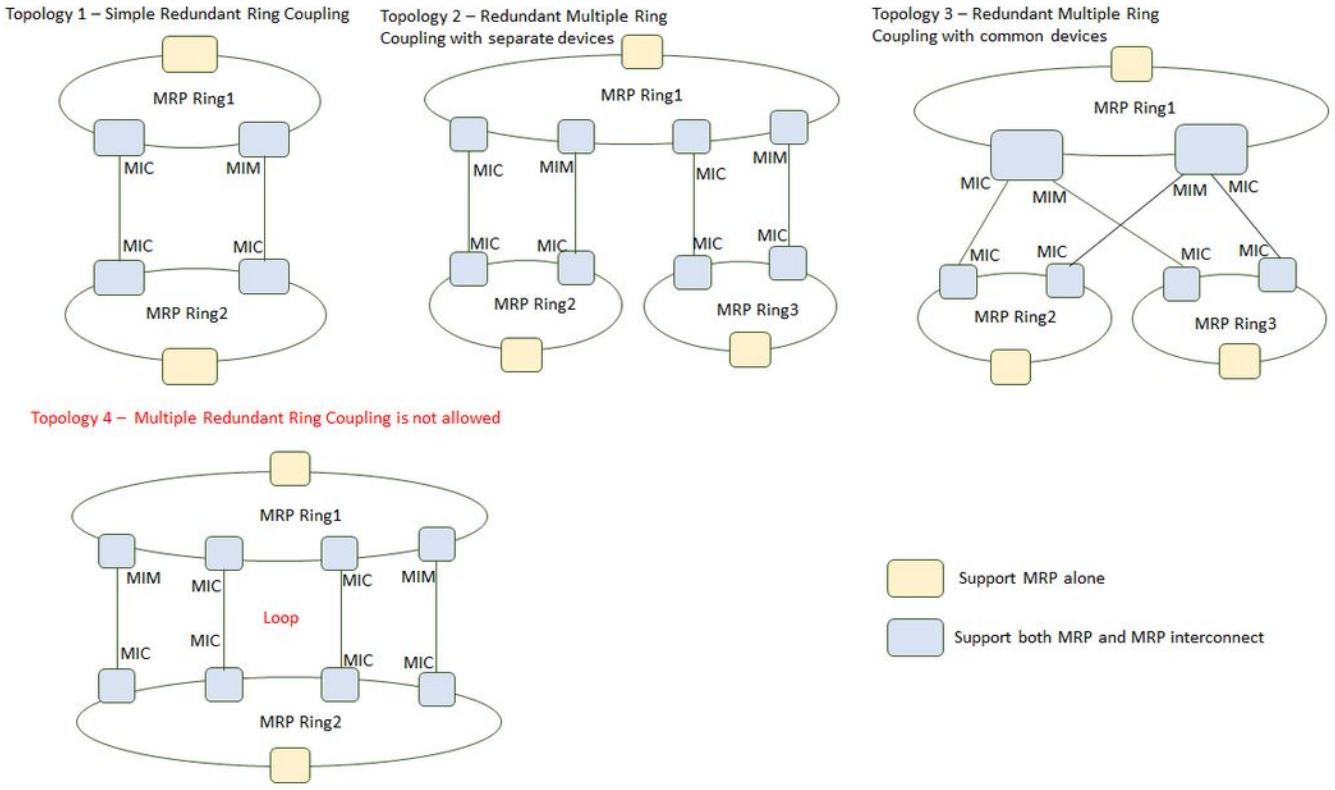


Table 1: Topology Description

Topology Number	Description
Topology 2	Redundant Multiple Ring Coupling with separate devices, multiple application of MRP Interconnection in one common ring, and other separate rings
Topology 3	Redundant Multiple Ring Coupling with common devices, multiple application of MRP Interconnection in one common ring, and other separate rings
Topology 4	Multiple application of MRP Interconnection in more than one common ring is not allowed. Forwarding links Loops cannot be resolved by MRP Interconnection protocol.
Topology 1	Basic MRP Interconnect functionality of simple redundant ring coupling requires one MIM with 3 MICs to be configured.

5. MRP Configuration Example

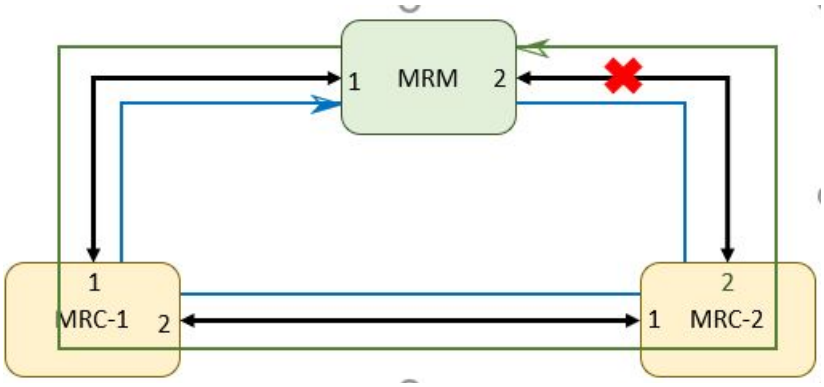
This example shows how *MRP* works when one of the *MRP* node is configured as *MRM* and other nodes as *MRC*.

CONTEXT:

A typical *MRP* scenario is shown below:

- **Normal Operation**

  During normal operation, redundant links on each mode form a closes ring. MRM transmitted MRP TEST frames are received back on adjacent ring ports, so MRM blocks one of its ring ports to make the ring "loop free" from communication point of view.



	Ring Port1	Ring Port 2
MRM	Forwarding	Blocked
MRC1	Forwarding	Forwarding
MRC2	Forwarding	Forwarding

Ethernet Wired connection

MRP TEST Frame from MRM Port1 to Port 2

MRP TEST Frame from MRM Port2 to Port 1

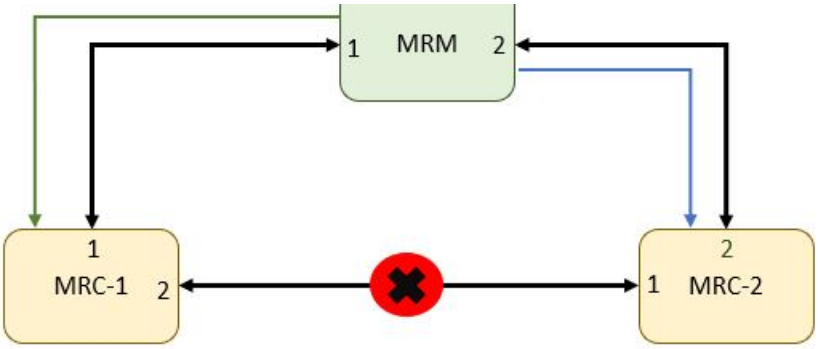
Port2 is Blocked, not tx & rx data traffic , Only control traffic flow on this port.

MRM Blocks port 2, so port 2 transmits and receives only control traffic. MRM transmits the data traffic via port 1 only, by which looping of data traffic in the network is avoided.

Data Traffic flow from MRM (via Port 2) ---> MRC 1 (via Port 1 & 2) ---> MRC 2 (via Port 1 & 2)

- **Error Scenario**

  As soon as the ring is open due to the link down and the data communication is broken, the MRM reconfigures the data paths within 200 ms (i.e. it unblocks the blocked ring port and creates new loop-free topology).



	Ring Port1	Ring Port 2
MRM	Forwarding	Forwarding
MRC1	Forwarding	Link Down
MRC2	Link Down	Forwarding

Ethernet Wired connection

MRP TEST Frame from MRM Port1 to Port 2

MRP TEST Frame from MRM Port2 to Port 1

Link down between MRC1 & MRC 2.

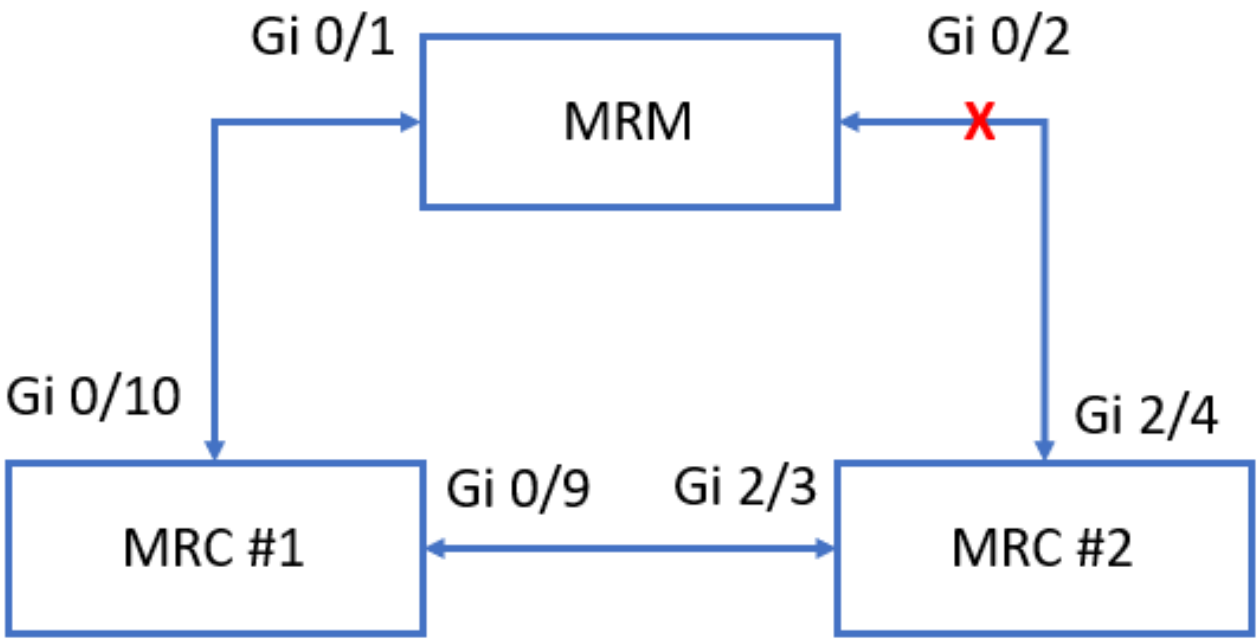
Ring is open due to the link fault between MRC 1 and MRC 2. MRM ports 1 & 2 are in forwarding state and transmit and receive both data and control traffic.

Data Traffic flow from MRM (via Port 1 & 2) ---> MRC 1 and MRC 2

5.1. Example 1

This topology consists of an *MRM* and two other *MRC* nodes.

CONTEXT:



The configuration steps for the as *MRM* and other two nodes as *MRC* are as follows:

1. *MRM* Configuration for the .

   FOR EXAMPLE: perform the following:

```
# configure terminal

(config) # mrp enable

(config)# mrp ringid 1

(config)# vid 2

(config-mrp)# mode manager port1 gigabitethernet 0/1 port2 gigabitethernet
0/2
```

```
(config-mrp)#end
```

2. *MRC* Configuration in MicroRaptor.

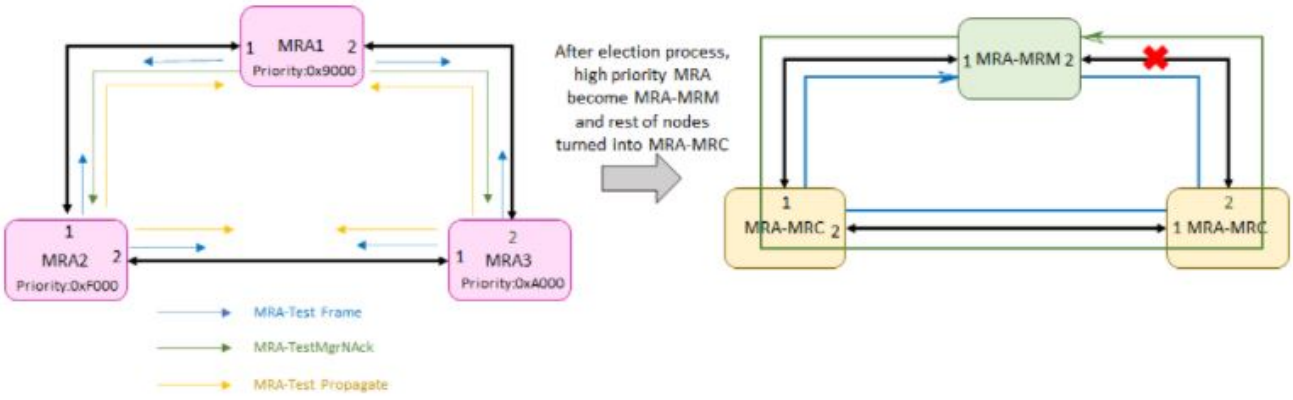
   FOR EXAMPLE: perform the following:

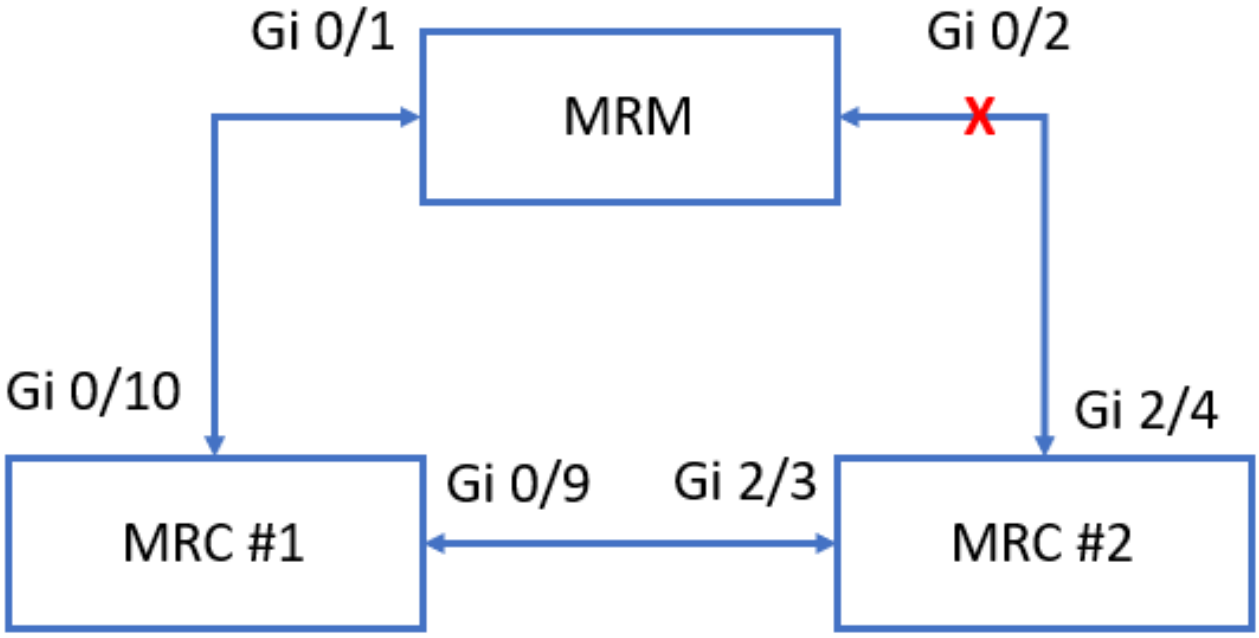
```
# configure terminal

(config)# mrp enable

(config)# mrp ringid 1

(config)# vid 2

(config-mrp)# mode client port1 gigabitethernet 0/9 port2 gigabitethernet
0/10

(config-mrp)# end
```

3. **How *MRP* Works when all *MRP* nodes are configured as *MRA*:**

   FOR EXAMPLE: Perform the following:

   Based on *MRA* election, one of *MRP* nodes becomes *MRM* and all other *MRP* nodes become *MRC*.





– The configuration steps for the **as *MRA*** are:

***MRA* Configuration in the with high Priority:**

```
# configure terminal

(config) mrp enable

(config)# mrp ringid 1

(config-mrp)# mode manager-autocomp port1 gigabitethernet 0/1 port2
gigabitethernet 0/2

(config-mrp-manager)# priority 36864

(config-if)#end
```

***MRA* Configuration in MRC #1 with low priority:**

```
# configure terminal
```

```
(config)# mrp enable

(config)# mrp ringid 1

(config-mrp)# mode manager-autocomp port1 gigabitethernet 0/1 port2
gigabitethernet 0/2

(config-mrp-manager)#priority 40964

(config-if)#end
```

NOTE: A high priority node has a the lowest priority value (e.g. the has a low priority value 36864). After election, the gets higher priority than the other two nodes and becomes *MRM.* The other two nodes become *MRC*.

4. *MRM* Interconnection Configuration. To configure MRP Interconnect, first MRP Ring instance needs to be created and then mode is configured along with the ring ports under MRP Config mode.

   FOR EXAMPLE: perform the following:

```
# configure terminal

(config) # mrp-intconn interconnectionid 1

(config - mrpintconn)# role mim in-port gigabitethernet 0/4
```

5. ***MRP* Show Commands in the**

   FOR EXAMPLE: Perform the following:

```
# show mrp ringid  1

# show mrp ringid  1 detail

# show mrp counters

# show mrp-intconn
```

```
# show mrp-intconn counters
```

6. ***MRP* Debug traces in the**

FOR EXAMPLE: Perform the following:

```
# debug mrpring ?


# debug mrpinterconnection all
```

7. ***MRP* Syslog**

FOR EXAMPLE: Perform the following:

```
# configure terminal

(config)# logging local flash critical file syslog.log

(config)# logging severity critical

(config)# end
```